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IN THE

Supreme Court of the United States

OCTOBER TERM, 1972.

No. 72-841

ECLIPSE FUEL ENGINEERING CO.,
Petitioner,

vs.

MAXON PREMIX BURNER COMPANY, INC.,
Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

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Respondent.

PETITION FOR A WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SEVENTH CIRCUIT.

Petitioner prays that a writ of certiorari be issued to review the judgment of the United States Court of Appeals for the Seventh Circuit entered on September 18, 1972, or initially, to direct that Court to take further action before possible further review by this Court.

OPINIONS BELOW.

The opinion of the Court of Appeals for the Seventh Circuit (Addendum IV herein) is reported at 175 USPQ 331, a correction in footnote 6, made upon denial of a petition for rehearing, not being shown in the advance sheet.

1. Now Maxon Corporation, but change of name not of record herein.

Findings of Fact and Conclusions of Law of the District Court (in part in Addendum II herein) are reported at 171 USPQ 138-165. The District Court did not file an opinion at the time of judgment. An unpublished opinion deciding post-trial motions, here involved, is addendum III, *infra.*

JURISDICTION.

The judgment of the Court of Appeals for the Seventh Circuit was dated and entered on September 18, 1972. A petition for rehearing was denied on November 1, 1972 (Addendum V). Jurisdiction of this Court is invoked under Title 28 U. S. Code, Section 1254(1).

QUESTIONS PRESENTED.

1. Preliminary Question: *Whether* (in the expected absence of adequate answers in the respondent's opposing brief to one or more controlling questions herein) *the judgment below should be reversed summarily, or at least vacated for further consideration* in view of:

A. *Schriber-Schroth Company* v. *Cleveland Trust Company,* 311 U. S. 211, 218 (1940). [File-wrapper estoppel can be applicable against broadening by construction.]

B. *Singer Company* v. *Cramer,* 92 U. S. 265, 276-285 (1904) and *Sanitary Refrigerator Company* v. *Winters* (1929), 280 U. S. 30, 35; *McClain* v. *Ortmayer* (1891), 141 U. S. 419. [Words of claim must be given due effect; and proper construction of claims is question of law freely determined on review.]

C. *Beckman Instruments Inc.* v. *Chemtronics, Inc.* (CA-5, 1970), 439 F. 2d 1369, 1374, 1378; cert. den. 400 U. S. 956. [Prior art beyond that considered by Patent Office and lack of frankness in Patent Office prosecution overcome presumption of validity.]

D. The failure of the Court of Appeals to consider whether the validity of a broadened claim can properly be based on an admission of validity or waiver made with respect to a narrower scope, especially when introducing prior art to preclude the broad scope.

E. The failure of the Court of Appeals to reconcile (1) its sua sponte holding that because Eclipse had "sufficient notice" there is no estoppel against Maxon, with (2) uncontested determination by District Court in Finding 25 that Eclipse might "fairly assume [that Maxon] acquiesced in Eclipse's contentions of noninfringement."

2. *Whether the holding that Eclipse has infringed Maxon's Reissue Patent No. 25,626 can stand.* More particularly, whether it can stand when:

A. Infringement is found by a broadening application of the patent claims, which Maxon concedes Eclipse could not foresee, and which Maxon itself did not think of until Eclipse's accused gas burners had been on the market for about four years, thus escaping by three years the time limit of 35 USC 251 for broadening by reissue, and escaping the statutory safeguards for intervenors in 35 USC 252;

B. Neither court below has shown concern with whether the adjudicated claims are being broadened beyond the scope intended upon issuance of the patent in suit; and in fact the claims *are* broadened by ignoring one express limitation therein, nullifying another, and applying others with a tortuous literalness in disregard of Eclipse's nonuse of the basic idea they represented;

C. The validity of the claims thus broadened was rested by the District Court solely on an admission of validity in prior litigation between the parties to this litigation, where the admission was with respect to the as-issued scope; Eclipse, in the present litigation, although deeming itself estopped as to that scope, having introduced prior art to

preclude the very scope to which its prior admission is now extended.

D. The Court of Appeals cast aside file-wrapper estoppel by citing a 7th Circuit decision holding (contrary to case law of this Court and other Circuit Courts) that file-wrapper estoppel is not available except when the means of recapturing that given up in the Patent Office is by the doctrine of equivalents;

E. Neither court below treated the question of whether, if the claims can be construed so broadly, they are invalid for lack of invention over the prior art and also because of indefiniteness; and neither court identified an inventive concept defined by the claim and used by Eclipse; and

F. The Court of Appeals treated as of "essentially factual nature" the District Court's findings which were inherently based on the legal question of claim interpretation.

3. *Whether the determination against laches and estoppel of Maxon can stand.* More particularly, whether it can stand when:

A. Finding 25, accepted by Maxon, holds Eclipse "might fairly assume" that Maxon "acquiesced" as to noninfringement; but the Court of Appeals, sua sponte held that Eclipse had "sufficient notice" to preclude estoppel;

B. Without taking note of Finding 25, the Court of Appeals reaches its contrary determination by relying, without hearing from Eclipse on this point, on facts which gave Eclipse no indication that Maxon was not acquiescing; facts which are totally consistent with continued acquiescence throughout the initial 1963-1965 period of investment of substantial sums by Eclipse in reliance on that acquiescence;

C. Even as late as the first notice of infringement, given in October of 1967, those Eclipse burners using outside or

"non-airstream" air for combustion were not charged to infringe (though later held to infringe); and

D. The Court of Appeals did not give approval to the District Court's acceptance of Maxon's excuse for laches that its management was not aware until 1966 that Eclipse had changed from its "noninfringing" uniformly-sized apertures in the forwardly diverging mixing plates of its burners; and in fact recognized that excuse to be inconsistent with Maxon's demand, promptly after winning judgment on that basis, to be free to charge infringement by the same uniformly-sized apertures.

4. Whether the District Court's post-judgment ruling (requested by Eclipse "to prevent the injunction order . . . from being ambiguous") that a 1963 prototype burner with uniformly-sized apertures did not infringe, can be properly reversed [vacated] by the Court of Appeals as de minimus,[2] when the reasons the District Court had given for its ruling included (a) mention that all adjudicated claims are limited to nonuniformity of hole size; (b) mention that an officer of Maxon had conceded during trial that burners with uniformly-sized apertures in the mixing plate walls would not infringe; and (c) the following statement:

> "Plaintiff cannot seek to excuse its laches by arguing that it did not know that there had been a change from the non-infringing uniform apertures to the infringing non-uniform apertures, and then urge that the uniform apertures should not be excluded from the coverage of the claims."

Although the sentence just quoted was part of the District Court's reasoning for its post-trial ruling of non-infringement by Eclipse burners with uniform apertures, it appears to constitute also a determination of a bar to

2. An additional reason, strangely introduced by the words "compelled by defendant's own actions," is because defendant, though furnishing detailed drawings to Maxon, had not known, in 1968, where the old 1963 prototype burner was then located.

Maxon's asserting the stated infringement, a bar which the Court of Appeals recognized could exist and did not reverse. Accordingly, a subsidiary question is whether this is so.

5. Whether, when Eclipse points to numerous matters in the record as constituting reasons for an award of attorney fees, or at least for finding Maxon lacking in equity, judgment for Maxon can be upheld without disposing of these matters; examples of these matters being found hereafter under item 1 of Reasons for Granting the Writ.

6. Whether the Court of Appeals gave too little weight to the public interest when refusing to remand for determining validity of the broadened claims, especially when, even aside from broadening: (a) no prior decision had held the particular claims involved in this litigation valid; (b) the presumption of validity had been overcome by important prior art not before the Patent Office, and (c) a newly enunciated doctrine would release Eclipse from all estoppel.

7. Whether panels including only one judge of the Court of Appeals should be encouraged by allowing to stand a decision (of such a panel) as far below the usual high standards of the Seventh Circuit as is apparent from the foregoing, especially where the public interest against undeserved patent monopoly is being defeated.

STATUTES HERE INVOLVED.

35 USC 103:

> "A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said

subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made."

35 USC 112, 2nd paragraph, 1st sentence:

"The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention."

35 USC 251, last paragraph:

"No reissued patent shall be granted enlarging the scope of the claims of the original patent unless applied for within two years from the grant of the original patent."

35 USC 252, second paragraph:

"No reissued patent shall abridge or affect the right of any person or his successors in business who made, purchased or used prior to the grant of a reissue anything patented by the reissued patent, to continue the use of, or to sell to others to be used or sold, the specific thing so made, purchased or used, unless the making, using or selling of such thing infringes a valid claim of the reissued patent which was in the original patent. The court before which such matter is in question may provide for the continued manufacture, use or sale of the thing made, purchased or used as specified, or for the manufacture, use or sale of which substantial preparation was made before the grant of the reissue, and it may also provide for the continued practice of any process patented by the reissue, practiced, or for the practice of which substantial preparation was made, prior to the grant of the reissue, to the extent and under such terms as the court deems equitable for the protection of investments made or business commenced before the grant of the reissue."

35 USC 285:

"The court in exceptional cases may award reasonable attorney fees to the prevailing party."

STATEMENT OF THE CASE.

Eclipse has now been held to infringe claims 3, 7, 8 and 10 of Reissue Patent 25,626.[3] These claims are "original claims" in that they were claims of Maxon's original patent 3,051,464 of which the patent in suit is a reissue.

Eclipse Relied on Maxon's Acquiescence in Noninfringement.

A list of dates, with an indication of the period of acquiescence, is provided for the Court's convenience as a chart comprising the first of two foldouts at the back of this petition.

In March 1963 Eclipse disclosed to Maxon the type of burner which it proposed to market as a noninfringing substitute for Eclipse's previous burner. Eclipse had already discontinued the previous burner after being sued, without notice, under Maxon's original patent shortly after it issued.

Maxon indicated willingness to concede noninfringement by the new burner, and settlement of the prior litigation soon resulted. Eclipse agreed not to make a burner covered by the patent claims and accepted a consent judgment holding the patent valid and infringed. Maxon, deeming the Eclipse burner out of its reach even by reissue, did not inform Eclipse that it had already filed an application for the reissue patent now in suit. The application had been filed after the above-mentioned disclosure to Maxon with a "confidential" notation, but (as Maxon has insisted) it was not filed to cover Eclipse.

That Maxon deemed the submitted Eclipse design out of its reach even by reissue shows it then recognized a *fundamental* difference. It could not then have been relying on

3. Jurisdiction of Federal courts lies under 28 USC 1338(a).

mere uniformity of apertures size (discussed below) because certain of Maxon's reissue claims, asserted in this litigation, do not all exclude uniform aperture size. Such claims are not among the adjudicated claims because, recognizing that Eclipse was not estopped to show their invalidity, Maxon moved that they be severed for separate trial, and this was ordered.

Before identifying the basic differences which were in 1963 easily recognized by those familiar with the Maxon file wrapper and the similar distinctions Maxon had relied upon to get its patent, mention of [illegible]ntial similarities might be helpful.

[Understanding of the next discussion may be aided by having in view the second fold-out at the back of this petition.]

Similarities Not Legally Significant Could Mislead.

Eclipse's new type of burner had certain similarities to Maxon's patented burner and these are mentioned first to make clear that they alone are not legally significant, because old in the art. Thus the Eclipse burner (shown at the bottom of the fold-out) is a line burner with perforated wings or forwardly diverging mixing plates. It extends across a duct carrying an airstream to be heated (the air of which in some instances is "make up air," and will be breathed by workers) and its flame is protected between the two perforated mixing plates through which air is supplied to successive parts of the flame for combustion purposes. Maxon had never even sought claims defining its burner this broadly, and did not complain before suit as to this underlying similarity. The danger of according significance to this similarity is heightened by the fact that no single prior art reference before the Patent Office or discussed by the courts below includes all of this. Nevertheless,

Maxon is in the position of admitting this much to be old in a prior art Scheller burner by introducing into evidence findings from the prior *Maxon* v. *Mid-Continent* suit describing such a burner (155 USPQ 434, 449, here PX 13A). [Eclipse contributed to the judicial failure to realize so much was old by failing to point this out to the District Court.] The Court of Appeals ignored this highly pertinent Scheller burner. The claims here involved could hardly have issued if the Patent Office had known of the Scheller burner, even though different claims were found valid in the *Mid-Continent* suit after Maxon persuaded the Court there to rule-out Scheller on clearly erroneous law not asserted here by Maxon.

Eclipse's New Burners Were Basically Different.

The adjudicated Eclipse burners differ from the burner of Maxon's patent (and from Eclipse's burner of the consent judgment) in many respects pertinent to the claims. One major difference is that the adjudicated burners are "air chamber" burners in that an outer imperforate sheet metal wall structure forms an air chamber on the outer side of each mixing plate. Thus the mixing plates are exposed only to their own carefully controlled source of combustion air (from the burner's own blower, usually) rather than to the existing or "as found" airstream for the heating of which the burner is provided. A major feature on which the patent in suit was granted was for the bare mixing plates to reach out into the existing airstream which, by impinging upon the outer surfaces of the mixing plates, was to give proper combustion if the airstream velocity was within the range of 1500 to 4000 feet per minute as specified in the adjudicated claims.

Another major departure of Eclipse was in not feeding through its gas orifices in the burner body a *combustible* mixture of gas and air as the adjudicated claims require. Eclipse's *noncombustible* fuel feed made flashback into the burner body or manifold impossible.

Before the Patent Office, Maxon repeatedly urged both of the features omitted by Eclipse as important distinctions by which the claims defined over the prior art. The Court of Appeals did not treat or apparently consider this fact.

Infringement Found by Accepting Afterthought Broadening Which Eclipse Could Not Foresee.

Maxon does not deny that Eclipse could not have foreseen the manner Maxon contrived (after 1967)[4] for applying its patent claims to Eclipse's "AH" line of burners. Maxon also does not deny using afterthoughts, but defends afterthoughts. One post-1967 afterthought includes treating the controlled air flow through Eclipse's closed air chambers as the "passing air stream" to which the claims require the mixing plates to be exposed. Although the velocity of the air moving through this air chamber is far below the range required by the claims, Maxon persuaded the courts below to find this range satisfied by the higher velocity of jets where a small portion of the pressured air leaves the air chambers when it has already passed the mixing plate apertures. Although there are two "independently of" clauses which cannot be satisfied when the air-chamber air is thus treated as the claims' "air stream", Maxon successfully diverted attention of the Court of Appeals from one of these (which is the more difficult to twist) to the other; and as to this other persuaded both courts below to adopt an unnatural meaning. This new meaning ("undisturbed") is contrary to the file-wrapper and natural meaning ("not dependent on).[5] This

4. The last of the Maxon afterthoughts could only have occurred to Maxon some time after its Oct. 1967 charge of infringement, or Maxon would not have at that time used the term "non-airstream air," nor have exempted in that charge those Eclipse burners supplying outside or "non-airstream" air to their air chambers. This notice of infringement is the second item of Addendum VI.

5. When replacing claims which defined shielding with claims which added the "independently of" phrases, Maxon argued that the new claims distinguished from burners "dependent on com-

amounts to nullification because Maxon's new meaning adds nothing to other claim language.[6]

In Broadening, Courts Below Ignored Eclipse's Omission of Patent's Basic Idea.

The specification of the patent in suit[7] makes a point that the burner "utilizes the air stream itself." The file history repeatedly emphasized that the claims could not be satisfied by prior art having an airstream provided by the

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pressor air for combustion." The avoidance by the Court of Appeals of treating this as file-wrapper estoppel is treated below in Item H under Reasons for Granting the Writ.

6. This lengthy footnote should not be needed but is provided in case Maxon denies, as it did below, that the claims are broadened.

The easier-to-twist limitation (applicable to all claims) requires a shielded zone:

> ". . . in which said variable low-rate combustion can take place *independently of and shielded from* the passing air stream" (emphasis added).

As to this the Court of Appeals said:

> "However, as the district court noted, 'independently of' is logically construed to mean undisturbed and unharmed by the passing air stream, and 'shielded from' implies that the combustion is protected and separated by the shielding walls from the passing air stream."

Neither court below made any attempt to explain how it is "logical" to so construe one of two phrases that it adds nothing to the other, especially when the one thus construed had been added because the other was not deemed by the Examiner to be enough.

Neither court asserted that the *other* "independently of" clause could be thus "construed". The Court of Appeals used the clause (page 10) without analysis. That clause, applicable to all claims, requires the low-rate burner to be:

> ". . . for variable low-rate combustion of combustible air-gas mixtures *independently of air from the passing air stream* . . ." (emphasis added).

But it is undisputed that combustion in the Eclipse burners is at all times dependent upon air from the air chamber (hence, from the "air stream" if the air-chamber air is to be treated as the "air stream" of the claims). There is never a combustible mixture of gas and air issuing from the gas orifices.

7. Addendum I, at column 5, line 31.

burner itself for combustion purposes. For example, in its first amendment (original patent file-wrapper, when inserting amendments defining coaction with the air stream) Maxon said its burner is placed "in an air stream which exists primarily for other purposes" and that "the references disclose no gas burner which interacts with an otherwise existing or passing air stream." Finding 54 identifies the basic conception underlying the patent as "a burner that harnessed the air stream and made it work for them instead of against them." The claims limit themselves to the existing airstream by requiring that the burner is "for heating" it. This is related in turn to the difficult coaction of the perforated mixing plates to this *existing* airstream (not air-chamber flow tailored to the burner's needs) by requiring the mixing plates to be exposed to the thus-defined "air stream."

All of this is disregarded when the claims are applied to Eclipse's special air-chamber air, especially where its pressure comes from the burner's own blower so that the existing airstream is not "harnessed" in any sense.[8]

Maxon Has Escaped the Sec. 103 Requirement for Unobviousness: Courts Below Applied Old Admission of Validity to Broadened Claims.

Trial was conducted with all concerned believing Eclipse to be estopped by its prior consent judgment from contesting validity of the claims.[9] Eclipse introduced prior art

8. If Maxon had selectively charged the few Eclipse burners which are used without their own blowers (or if Maxon should now do so), it would have a cognizable argument as to harnessing the existing airstream, but not as to the "independently of" clauses, nor as to wide divergence of the mixing plates for intercepting an existing, relatively open, airstream.

9. This was the *apparent* law at the time. In an unrelated case, a decision in the same District had upheld estoppel. It was later reversed by the 7th Circuit Court of Appeals (*Business Forms Finishing Service, Inc.* v. *Carson*, 452 F. 2d 70, 1971).

to limit the claims and mentioned to the Court its duty to protect the public from invalid claims. Nevertheless, while holding the four adjudicated claims infringed by a broadening construction, the District Court did not adjudicate validity as to that broadened construction, but disposed of the validity question on the grounds of admitted validity found in the prior consent judgment.

The opinion of the Court of Appeals paid no attention to Eclipse's arguments that the broadened scope of the claims determined by the District Court had not been reached by any admission of validity by Eclipse, and that claims of that scope are not even entitled to a presumption of validity (because no longer requiring the very features by which the Examiner was persuaded to find the claims allowable). It paid no attention to the point that courts commonly recognize a varying validity status in claims, as when a court says anything like "Not infringed if interpreted to be valid; invalid if interpreted to be infringed."

Even forgetting that the claims had been judicially broadened, the Court of Appeals gave too little weight to a consideration which it mentioned, that "public policy encourages tests of patent validity." The Court offset this with "public policy also favors conservation of judicial time and limitations on expensive litigation" and held that "Eclipse effectively waived any rights it might otherwise have to challenge the validity of Maxon's patent through its actions during the course of the trial," not withstanding the fact that Eclipse in its answer and counterclaim asserted invalidity.

In so ruling, the Court of Appeals overlooked the following considerations:

(a) Even had Eclipse not introduced prior art, it ought not to be deemed to have waived any rights by conducting its trial in accordance with the prevailing law of the district, the District Court decision in *Business Forms* (previous footnote) not yet having been reversed.

(b) Having introduced prior art to limit the scope of the claims, Eclipse was at least entitled to have considered by both courts below the question of what was obvious in view of the total prior art available in the record. Maxon has completely escaped the requirement that it must not monopolize that which is obvious to persons of ordinary skill. The Court of Appeals has grossly failed in protecting the public interest when it lets that escape occur.

(c) By the Court of Appeals own reversal of the District Court in its finding of no infringement where uniformly-sized apertures are used, it was making further litigation necessary anyway, and the public might as well be protected by allowing validity to be included in this further litigation. Although at the time of its decision, the Court of Appeals did not realize that under that decision further litigation was certain to ensue,[10] it still did not open up the question of validity when offered an affidavit that Eclipse had already changed to burners with uniformly-sized apertures.

The three foregoing considerations of course would not have needed to be considered, had the Court of Appeals recognizd that broadened claims present a new question of validity to which admissions prior to the broadening are not applicable.

Court, Sua Sponte, Found Maxon's Estoppel Negated by "Sufficient Notice" to Eclipse, Contrary to District Court Finding.

The District Court found (finding 25) "that Eclipse might fairly assume that by Maxon's silence . . . it acquiesced . . ." Of two reasons the District Court gave for

10. The Court of Appeals, sua sponte, said Eclipse had not even threatened to make more burners with uniformly-sized apertures. Actually, the record shows Eclipse had offered to change to uniformly-sized apertures.

not finding laches, the Court of Appeals gave only passing reference to one and expressly avoided reliance on the other, substituting its own basis contrary to Finding 25, namely, that Eclipse had "sufficient notice." Maxon had made no argument that Eclipse had had sufficient notice; nor that Eclipse had had *any* notice prior to 1966. In finding, sua sponte and without the benefit of any argument that Eclipse had had "sufficient notice," the Court of Appeals showed no awareness of the above-quoted finding to the contrary. It therefore left unanswered the following vital (and unanswerable) questions raised by the conflict with Finding 25 and by the supposed means by which the Court found "sufficient notice":

1. How could the prior litigation against Eclipse, mentioned by the Court of Appeals as its first element of sufficient notice, give Eclipse any reason to suspect that its new burner was in danger, when the settlement was based on Maxon's acquiescence that the new style of burner fully disclosed to it was in the clear?

2. How could the Court's next element, that Maxon was suing Mid-Continent, give Eclipse any reason to think it was in danger, in view of the foregoing and in view of the fact that Eclipse's new "AH" burner was so different from that of Mid-Continent that, as stated in Finding 7 (Addendum II, infra), a different group of claims was asserted in the *Mid-Continent* suit than here?

3. Is it not clear that Eclipse was "spending funds in designing, engineering, advertising and marketing of new burners" (per Finding 25) and in fact vast sums, before any indication from Maxon even began to becloud the apparent acquiescence of Maxon indicated by Finding 25?

4. Even if the 1966 letter mentioned in Decision Footnote 7 is [erroneously][11] deemed a notice of infringement,

11. Contrary to Footnote 7 in the opinion of the Court of Appeals, the letter of January, 1966 did not state an opinion of

and even if that or the October 1967 charge of infringement is [erroneously] deemed early enough to exclude laches as to the burners it charged to infringe, isn't there clearly estoppel against charging infringement by those of the Eclipse burners (using outside or "non-airstream" air) which remained uncharged until suit was filed?

The original opinion of the Court of Appeals shows that its decision denying estoppel was made on the erroneous assumption that the District Court had denied monetary relief because of laches, and that the question was of enjoining further infringement. In an order denying rehearing, the Court corrected its footnote 6 which stated the misassumption.[12] Although this left the opinion apparently justifying only an injunction, not monetary relief, the affirmance was left standing even though its unstated effect was to affirm the award of monetary relief.

REASONS FOR GRANTING THE WRIT.

1. *Without action by this Court, at least to the extent of preliminarily exercising its power of supervision* (as by directing the Court of Appeals to treat the untreated points noted herein and to explain its reasoning where appropriate), *a most outrageous abuse of the patent system will stand successful, doing great damage to the public and to one of the most guiltless defendants ever held to infringe.*[13]

Maxon's counsel that Eclipse was infringing. It stated disagreement with only one of several theories of noninfringement in the letter of July 20, 1965 to which it replied. Maxon's basis of disagreement did not apply to those Eclipse burners using outside air in the closed air chambers for combustion. The letter is p. A-54 in Addendum VI.

12. The correction included a new error in saying that Maxon had not appealed from the refusal to award treble damages and attorney fees. Maxon appealed but silently dropped its appeal after Eclipse filed its brief.

13. Probably never before has a defendant been held to infringe after the patentee's indication of clearance before the defendant began production, with notice of infringement given only after four years of open production.

As to the outrageous abuse, there can be no uncertainty as to the following: (1) Maxon has succeeded in having held to be infringements those burners of Eclipse using outside or nonairstream air which were exempted from its October 1967 charge of infringement. (2) All of the rest of Eclipse burners held to infringe, except a few not having their own blowers, are indistinguishable (as to infringement questions) from those continuously sold openly and advertised by Eclipse at least since early 1964, without charge of infringement being made until 1967; and without any reason to think Eclipse disagreed with even one of the various grounds of noninfringement until 1966. (3) Maxon did not regard the Eclipse burners as infringements until at least 1966, this being admitted by Maxon. (4) Either Maxon did not have any view of infringement in which its counsel concurred much before October 1967, or Maxon was in the interim *willfully* avoiding giving Eclipse any warning. (5) As late as October 1967 Maxon still had not invented all of the theories by which Eclipse is held to infringe, but Maxon nevertheless wielded the "big club" in this litigation by charging willful infringement. (6) Maxon has succeeded in its charge of infringement by ignoring the more difficult to twist of two "independently of" clauses in the claims, and leading the Court of Appeals to do likewise.

From the foregoing certainties, especially the last thereof, questions of lack of sincerity arise. When a claim limitation can not be fairly faced, how could any corporation advised by patent counsel have made its charges or brought suit in good faith? [Unless some hope of success is good faith even if based on hope that courts (drawn from lawyers who ethically refrained from patent matters) can be diverted from giving attention to that limitation.] Can a patent lawyer in good faith have proposed Finding 85 with its necessary implication that a claim limitation as to where the air comes from can be ignored because the "burner doesn't know and doesn't care where the air comes

from"? Is not the absence of any statement of doctrine or authority to support the implication evidence of realization that there is no such doctrine?[14] Can a patent lawyer in good faith, in the same brief in which he diverted the court's attention from a key limitation, have said at two points in the brief that the District Court findings had found the claims to "read on" the Eclipse burners when such language is not in the findings? And especially can this have been good faith when the District Court, in adopting Maxon's proposed findings, had struck "literally" or words of similar meaning in six places![15]

Is not Maxon's use of the matter of change in aperture sizes just shocking sham? From the Court of Appeals decision alone it is clear that until winning its District Court judgment, Maxon based its excuse for laches on noninfringement by the 1963 prototype because it had uniformly-sized apertures; and promptly after judgment reversed its position by insisting on the right to charge infringement by that very prototype. Furthermore, Maxon's virtually unsupported claim to have been influenced by assumed hole size is clearly inconsistent, anyway, with established facts: (1) Maxon's October 1967 notice of infringement described changes in the burner (to excuse Maxon's reneging on clearance given in 1963) but did not mention the hole size change, though Maxon admits knowing of it by 1966. (2) If the Eclipse burners of 1963-65 really had had the "assumed" uniformly-sized apertures, and if this had then been deemed by Maxon for that reason to escape the claims now adjudicated, it still would not have excused Maxon's silence because other asserted claims (severed for a later trial, per Finding 6) do not exclude

14. Similar criticism of this "sophism" in Eclipse's appeal brief was answered only by passing it off as having criticized the District Court's findings as including sophisms. Proposed findings are excluded from the record by District Court Civil Rule 13, but surely Maxon will not seriously deny authorship.

15. Shown by the Record because noted in a post-trial brief.

uniformly-sized apertures. (3) Because Maxon had Eclipse literature showing non-uniform hole size, the failure of Maxon to see this in the literature is inconceivable if Maxon was paying any attention to hole size.

If Maxon's claim to have relied on assumed uniformity of hole size is sham, then its claim to have been misled on that point in 1965 by submission to it of a drawing showing uniformly-sized holes, is also sham. The drawing *could* have misled Maxon, inadvertently;[16] but since it is clear now that Maxon was not paying attention to hole size, the inadvertent misleading did not reach fruition. Of course, estoppel by reliance on Maxon's acquiescence had already arisen anyway, before this supposed instance of Maxon's being misled for a few months.

Of many other instances (extending back into Patent Office prosecution) in which Maxon's sincerity is at best questionable, these examples are here given:

A. In the Patent Office Maxon submitted, just before allowance, an affidavit of comparative tests which Eclipse charges to have been clearly specious. Maxon's nearest approach to denying speciousness was that in the decision against Mid-Continent [where the specified speciousness is not mentioned] the affidavit and test were approved.

B. Maxon's post trial brief informed the District Court, in arguing infringement of that "independently of" limitation which Maxon neglected in the Court of Appeals, that in the decision against Mid-Continent a burner with similar construction (at points critical as to that limitation) had been held infringed. Maxon did not mention that the claims in that other litigation included no such "independently of" limitation. With that

16. Maxon has not charged more than inadvertence since the Eclipse main brief in the Court of Appeals pointed out clear circumstantial evidence of inadvertence, including Eclipse's having used the same drawing in seeking an opinion from its own counsel.

noted, citing the precedent would have been pointless.

C. Maxon wielded the big club of treble damages and attorney fees, for willful infringement, and when these were denied, Maxon appealed, even though not contesting the District Court's finding that, having disclosed to Maxon its intended burner, Eclipse could fairly assume that Maxon acquiesced in noninfringement. [The appeal was dropped after the Eclipse brief criticized "inexcusable" use of the "big club".]

2. If this Court allows to stand the successful abuse shown above, patentees (who collectively have their fair share of human greed and face great temptations) will be encouraged, by the successful claim-stretching and estoppel-invasion here, to assert their patents, and even sue on them, beyond any reasonable basis. And no matter how clearly wrong a decision is, a patentee will be encouraged to stand firm on the error on the basis that the odds overwhelmingly favor denial of the petition to this Court. This petition does not seek any whittling-down of the patent system, only the exclusion from it of gross excess.

3. There is a great public need for this Court to consider the general question of stretching patent protection by broadening of patent claims beyond their original or plain-language meaning. It is not the contention of this petitioner that no broadening is ever permissible. The contention is rather that broadening must be limited and subject to safeguards of equity;[17] and that the outermost tolerable limit, exceeded here, is that which is reasonably foreseeable by a competitor's study of the patent; but it

17. The question of equitable safeguards need not be reached here because the broadening is beyond limits. There is, however, great need for this Court to establish that if broadening by courts is ever permissible, e.g. under the doctrine of equivalents, there can be equitable safeguards for the surprised defendant of good faith. One example of equitable safeguard is intervening rights. Origi-

must not recapture that which was given up in the Patent Office in order to obtain the patent. This need is especially strong when, as here, important prior art not before the Patent Office makes it very unlikely that with knowledge thereof the Patent Office would have allowed the present claims.

If the broadening achieved here were to be allowed to stand, there would be a strange thwarting of the statutory limitations on broadening by reissue. Here the broadening was not conceived (certainly not acted upon to the extent of charging infringement) until October 1967; some of the broadening being still later. But the patent issued in 1962, and 35 USC 251 limits to two years after issue such broadening by reissue. And reissue has safeguards not effective here: (1) the amount of broadening is made definite by a new claim; (2) the new claim must be approved by the Patent Office (and the Patent Office must be informed of any known additional prior art), and (3) intervening rights to prevent any unfairness from resulting are provided by 35 USC 252.

The point is clarified by comparing the effect of the broadened "independently of" language in reissue-broadened claim 12, with broadening accomplished in this suit by ignoring the corresponding clause completely. Claim 12 reads (emphasis added) "*substantially* independently." The broadening in this suit is far greater than the Patent Office permitted by the insertion of the word "substantially," and it escapes the application of intervening rights. The escape is shown here by the order of accounting and by the District Court's refusal to consider non-statutory intervening rights (p. A-31 infra).

Moreover, if in 1967 Maxon had still been free to seek a broadening reissue and had done so, it would have been obliged to inform the Patent Office of the prior art Scheller

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nally, intervening rights were provided by court-made law for reissues (e.g. *Keller* v. *Adams-Campbell Co.*, 264 U. S. 314, 317; 1924). Such rights could be provided again as justice requires.

burner, of which it then had knowledge, and the Patent Office would have had a chance to reject its original claims as well as the broadening being sought.

4. There is a great public need for considering the interaction between broadening patent claims by construction and questions of validity. Is a claim to be presumed valid with a scope broader than the basis on which it was allowed? Is an admission of validity (with only the plain-language scope in view) to be binding as to a broadened scope of claim?

5. Unless this Court acts, the Seventh Circuit, at least, will be governed by the doctrine that file-wrapper estoppel is available to a defendant only when the means by which a patentee seeks to recapture that which he gave up to obtain his patent is by use of the doctrine of equivalents; there being no limit competitors can count on as to stretching claims by construction.

6. Unless this Court acts, the Seventh Circuit, at least, will continue to give District Court findings excessive weight where claim interpretation is involved, not recognizing that interpretation is a question of law.

7. Unless this Court acts, District Courts, at least in the Seventh Circuit, will be reluctant even after a long trial to include rulings on a small-quantity aspect that may guide the parties and avoid new litigation, even when it leaves a patentee free to charge infringement by that which he has, to escape laches, asserted did not infringe.

8. Unless this Court acts, the Seventh Circuit (surely no other Circuit Court would follow)[18] will continue to spare patentees from laches and even from estoppel by treating as "sufficient notice" prior enforcement actions

18. The Court of Appeals here thought it was following its own prior decision in *Armstrong* v. *Motorola Inc.*, 374 F. 2d 764, 769 (1967) cert. denied 389 U. S. 830, overlooking the vital distinction that in *Armstrong* Motorola was given early notice of infringement.

against other defendants which could not possibly have warned the new defendant of any danger to his fundamentally different product, reasonably believed not to infringe.

9. By taking action here this Court can make clear that there is some minimum standard below which decisions of Courts of Appeals may not be tolerated by this Court. At the same time this Court could urge greater efforts in that most difficult judicial task of recognizing controlling error when pointed out by petition for rehearing; and could set a standard of frankness in courts in patent matters.[19]

This Court perhaps might have been spared any petition in this case had the Court of Appeals given adequate consideration on petition even to the one point of "sufficient notice" on which it had acted sua sponte without hearing Eclipse on that point, and without showing awareness of inconsistency with Finding 25.

In its opinion the Court of Appeals ignored numerous points of Eclipse which until disposed of, would be controlling in favor of Eclipse. Some have been mentioned above. A list here may show the enormity, and could also serve as the basis of an initial directive to the Court of Appeals if a writ is issued. No judgment against Eclipse should stand, and perhaps this Court should delay full review, until the Court of Appeals has remedied the following neglect or clearly erroneous treatment of potentially controlling questions.

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19. The public interest where monopoly is sought has already resulted in a high standard in the Patent Office. (*Precision Instrument Manufacturing Co.* v. *Automotive Maintenance Machinery Co.* (1945), 324 U. S. 806, 818). Any standard of frankness in the courts should apply to both sides. The less obvious public interest where the patent is being attacked is in the proper working of the patent system in its public-benefit incentive function, and the public interest in justice. This case proves that, at least in patent matters, an opposition advocate can not always overcome lack of frankness.

A. Failure to treat Eclipse's omission of the underlying idea of having the mixing plates "reach out" into the existing troublesome airstream to cooperate successfully with it.

B. Failure to treat the "independently of air from" clause as to its natural and file-wrapper meaning, "not dependent on."[20]

C. In treating the clause "independently of and shielded from", failing to treat the points (1) that the meaning it gave to "independently of" left this phrase adding nothing to "shielded from," and (2) that the file wrapper shows the meaning to be the natural meaning, "not dependant on."

D. In its treatment of findings as being "of an essentially factual nature," failing to consider whether interpretation of the claim was involved and if so, whether "proper legal criteria" were used in the interpretation; in fact, ignoring citation of its own numerous "proper legal criteria" precedents. (Example: *Aerosol Research Co.* v. *Scoville Mfg. Co.*, 334 F. 2d 751, 141 USPQ 758; 1954). Also failing to recognize that the District Court's evaluation of the file history is fully reviewable.

E. In holding that the District Court had rejected the "factual basis" of the Eclipse noninfringement argument that some of its burners use outside air in the air chambers. It is undisputed that the Eclipse "RAH" burners do so.

F. In ruling against Eclipse's argument that relevant airstream speed should be taken where it impinges on the mixing plates (where Maxon admits the airspeed is below the claimed range) without considering that neither the patent nor its file wrapper gives support to Maxon's alternative, and that the choice is mainly proper legal interpretation of the patent document.

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20. If the opinion had this clause in mind in its observation that "the patent claims themselves contemplate that the burner may take some air from the passing air stream", then explanation is needed as to the clauses relied upon and whether they can nullify an express further limitation.

G. In its treatment of "widely divergent", failing to treat the point that the file-history significance of this was having enough divergence to coact satisfactorily with a relatively unconfined existing airstream; also (though not a controlling point) failing to take note (when denying that Maxon had asserted 50° to be critical) of Eclipse's quotation from the file wrapper in which Maxon took issue with the Examiner's position that 50° is not critical.

H. In dismissing the file-wrapper estoppel argument of Eclipse as "essentially frivolous" by relying only on District Court Findings which did not meet the specific estoppel which Eclipse had pointed out, and on a Seventh Circuit sometimes-doctrine that file wrapper estoppel is available only to bar use of the doctrine of equivalents, not to prevent recapture of scope given up by amendment in the Patent Office if the *recapture is by a broadening* construction.[21]

I. In disposing of prior art items one-by-one instead of considering what they collectively made obvious.

J. In treating the Eclipse contention that the prior art Western Products burner stands between the Maxon patent and Eclipse burners, failing to treat the Eclipse starting

21. The decision, *Paper Converting Machine Co.* v. *F M C Corporation*, 409 F. 2d 344, 354 (7th Cir.), *cert. denied*, 396 U. S. 877 (1969), must have been cited, as it was by Maxon, for this doctrine. This is not the law. "Where the patentee in the course of his application in the patent office has, by amendment, cancelled or surrendered claims, those which are allowed are to be read in the light of those abandoned and an abandoned claim cannot be revived and restored to the patent by reading it *by construction* into the claims which are allowed." (Emphasis added), *Schriber-Schroth Company* v. *Cleveland Trust Company*, 311 U. S. 211, 218 (1940). See similar statement by the 7th circuit, 1971, in *Ellipse Corp.* v. *Ford Motor Co.*, 452 F. 2d 163, 168; 171 USPQ 513. See also *Graham* v. *John Deere Co.* (1966), 383 U. S. 1, 33; 148 USPQ 459, 473, *Morpul, Inc.* v. *Glen Raven Knitting Mill, Inc.* (MD. N. Car. 1965), 144 USPQ 460, 464, 466, *Smith* v. *Florence-Mayo Nuway Co.* (CA-4, 1950), 182 F. 2d 507, 509; 85 USPQ 433, 435, *Power Curbers, Inc.* v. *E. D. Etnyce & Co.* (CA-4, 1962), 298 F. 2d 484; 132 USPQ 158, 166, and *Baker-Cammack Hosiery Mills* v. *Davis Co.* (CA-4, 1950), 181 F. 2d 550, 563; 85 USPQ 94.

point for this that the broad idea of extending the range of prior art line burners by diverging perforated shielding and mixing plate structure was completely obvious from common use of such structure elsewhere and was, in fact, old (see reference to Scheller, above at p. 10).

K. In holding that Eclipse had waived the contesting of validity, failing to treat the Eclipse assertion that no admission of validity had reached to the claims as broadened, and that Eclipse had, in effect, attacked the validity of that scope by introducing prior art to preclude it.

L. Failing to treat the fact that there had been no district court findings on what was obvious from the prior art and that taking validity as admitted indicated, even as to proper scope, that obviousness had not been considered.

M. Failing to treat the fact that no inventive concept had been identified, as held to be necessary for finding infringement in *Business Forms, supra* (452 F. 2d 70; October 15, 1971, concurred in by the same Circuit judge who wrote the present opinion).

N. On estoppel, in regard to the Court's sua sponte basis of denial that Eclipse had "sufficient notice," failing to hear Eclipse, and failing to consider when Eclipse first had reason to realize it could no longer "fairly assume" Maxon's acquiescence in its noninfringement, and whether in view of reliance by Eclipse prior thereto laches or estoppel had already arisen.

O. In case the determination of "sufficient notice" is withdrawn, failing to consider whether the evidence, and Maxon's reversal of position, show Maxon's excuse for laches to have been sham or at least of no significance.

P. Regarding the 1963 prototype, failing to reach a conclusion on the question it recognized of Maxon's being barred; failing to consider as a question of law whether a determination made by the District Court can be re-

versed as de minimus; failing (in giving Maxon a better chance to prove infringement by the 1963 prototype) to consider Maxon's failure to pursue availability of any information it needed, or claims to have needed, after Eclipse's first answer that it did not know the location of a burner from five years previous.

Q. Failure to treat other potentially controlling (but relatively independent) questions:

(1) Whether (if the infringement and no-estoppel holdings stand) Eclipse is a good faith infringer taken by surprise, and if so whether any equitable doctrine such as intervening rights should ameliorate unfairness. See footnote 17 above.

(2) Whether Maxon has failed to meet a monopoly-seeker's minimum standard of frankness and sincerity before the Patent Office and the courts, so as to be disentitled to relief and possibly be liable for attorney fees. This question could be referred by the Court of Appeals to the District Court for re-evaluation in light of Maxon's post-judgment actions.

CONCLUSION.

For the foregoing reasons, the petition for a writ of certiorari should be granted.

Respectfully submitted,

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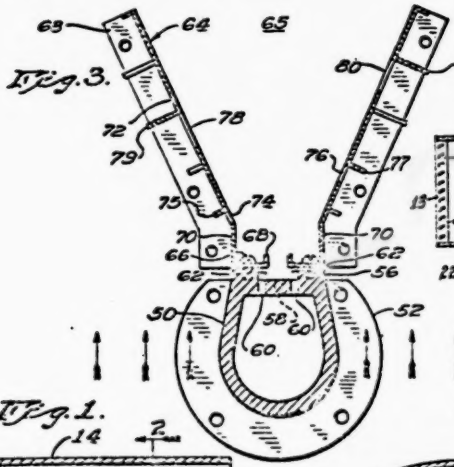
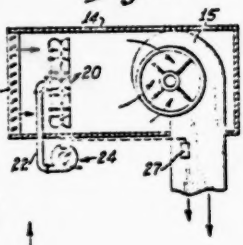
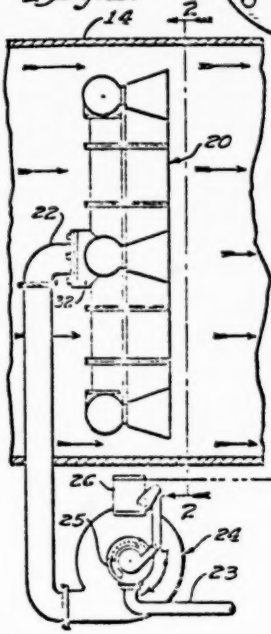
July 28, 1964 R. H. YEO ETAL Re. 25,626

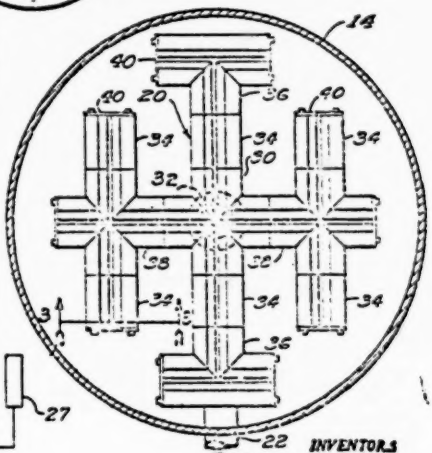
AIR-HEATING GAS BURNER

Original Filed Oct. 20, 1958 3 Sheets-Sheet 1









INVENTORS
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PLAINTIFF'S EXHIBIT
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AIR-HEATING GAS BURNER

Original Filed Oct. 20, 1958 3 Sheets-Sheet 2

Fig. 5.

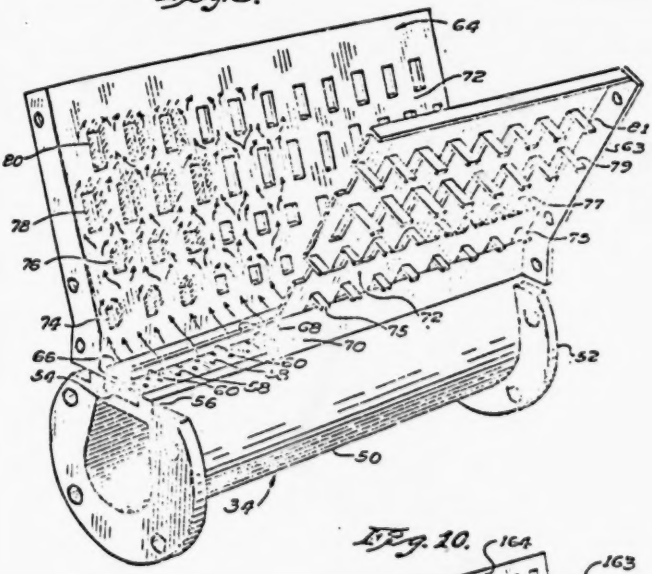


Fig. 10.

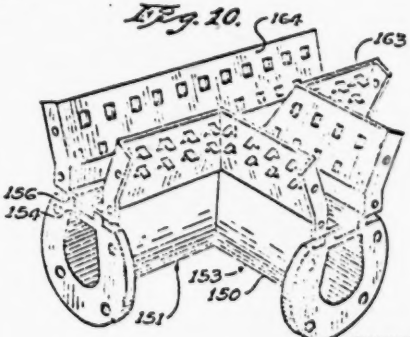
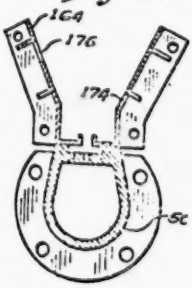


Fig. 9.



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AIR-HEATING GAS BURNER

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Fig. 6.

Fig. 7.

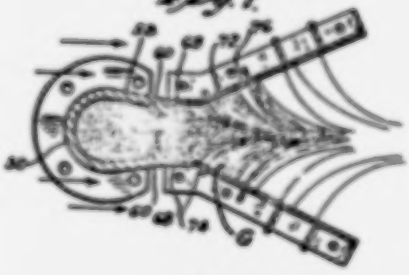
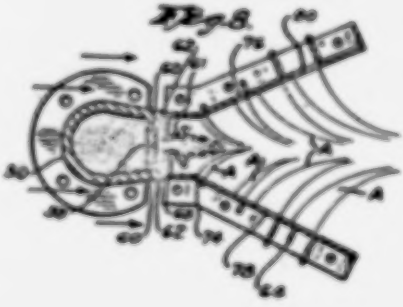


Fig. 8.



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United States Patent Office

Re. 25,626

Reissued July 28, 1964

25,626

AIR-HEATING GAS BURNER

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Original No. 3,051,194, dated Aug. 28, 1962, Ser. No. 58,261, Oct. 23, 1951. Application for reissue May 23, 1963, Ser. No. 284,774

17 Claims. (Cl. 263—19)

Matter enclosed in heavy brackets [ ] appears in the original patent but forms no part of this reissue specification; matter printed in italics indicates the additions made by reissue.

This invention relates to gas burners, and to gas-burner means for intimately mixing fuel gas, or gas-air mixtures, with additional air known as air for complete and clean combustion. It is a particular purpose of the invention to provide a gas burner which, while having other uses, is especially adapted for operation in an air stream to heat the air of such stream and which will utilize the air of the air stream to supply part or all of the air required for high-capacity combustion of the gaseous fuel. It is a further particular purpose of the invention to provide an air-heating burner combination which will have a high turn-down ratio, that is, a high ratio between its maximum and minimum rates of operation, and which can be readily throttled or adjusted over its whole range of operation with smooth and continuous variation of its heat output. By "air" we mean both normal air and oxygen-containing gas in streams other than fresh air streams, such for example as a recirculating industrial oven atmosphere containing less than a normal percentage of oxygen.

The invention is applicable to a number of different air heating applications and provides various advantages over prior burners available for such applications. These applications include the following, which are cited as illustrative and not by way of limitation.

I. *Heating air for factories and other manufacturing and processing establishments,* as to supply heated air for ventilating and other purposes, supplementing normal space heating facilities.—In recent years it has become increasingly common practice to exhaust large quantities of air from inside industrial or commercial buildings for the removal of fumes, vapors, dust, or other foreign or worse material deleterious to the workers or to the product being handled or to the operations being carried on within the building. The exhausted air is replaced by fresh air taken in from outside the building, and when the outside air is below room temperature it is necessary to heat this replacement or "make-up" air, and frequently to heat it to a very closely controlled temperature, in order to avoid discomfort to the workers or damage to the product or process within the building. It is also essential that the heated air be clean and dust free. In painting operations, for example, large volumes of clean make-up air are required to be supplied to painting booths and such air must be within close temperature limits both for comfort and in order to maintain uniform painting conditions.

A basic problem in this type of heating application is the wide variation in heat inputs required from the gas burner system. If the desired temperature within the building is 70° F. and the outdoor air is 66° F., there will be only 4° F. differential between the temperatures of the outside and inside air. Under such conditions, while heating will be unavoidable, the heat input required from the gas burners will be extremely small. Conversely, in severe winter weather the temperature of the outdoor air may be as low as −10° F., and the temperature differential will then be 80° F., which will require a very high heat input from the gas burners being used to heat the make-up air for the building. Accordingly, it is necessary that the gas burner system be capable of operating through

a wide range of heat inputs. The relationship between the extreme maximum heat input and the extreme minimum heat input in air-stream burners is desirably not less than a ratio of 25-to-1, and preferably greater. A further problem in such application is the need to adjust the heating rate, over that whole range, in order to meet the continuously variable heat demand.

The most satisfactory gas burners previously available for heating make-up air are the so-called line burners, in which a burner assembly is arranged across the stream of make-up air and in which combustion occurs directly in the air stream at a series of closely spaced or overlapping points along the lines of a pattern distributed across the air stream. While such burners provide clean combustion of gaseous fuel when operating conditions are favorable, they have narrowly limited operating characteristics. Their poor flame retention ability severely limits their maximum operating rate in air stream applications, and limits the air stream velocities in which they can be used. These limitations severely restrict their turn-down ratio in air stream applications. Their turn-down ratio is also held down by the limits on fuel mixture pressures and discharge velocities which must not be exceeded if flame retention is to be maintained.

Neither such line burners nor any other single gas burner system within our knowledge heretofore available for make-up air installations is capable of providing the 25-to-1 turn-down range needed in such installations. Accordingly, it has heretofore been necessary to use a costly multiple arrangement of two or more gas burner systems with part of the gas burners being automatically shut off and turned on as the temperature differential between inside and outside air varies to change the heat demand. Not only are these multiple systems costly, but in them it is impossible to avoid abrupt changes in heating rate when part of the gas burners are turned on and off, with the result that there is a sudden jump in air temperature when the supplementary burners are turned on and a sudden drop in air temperature when the supplementary burners are turned off. These sudden changes are highly objectionable.

There is thus an acute need in the industry for a gas burner system which can be throttled or adjusted smoothly and continuously throughout a broad range of heat inputs without alternatively turning on or off any portion of the gas burner system. It is one of the objects of our invention to meet this need and to provide additional improvements in burners for this air-heating application.

II. Supplying heat for industrial ovens and similar facilities in which hot-air-in-motion is used as a processing medium for drying, baking, curing, tempering, and other similar industrial or commercial processes.—Many industrial oven installations recirculate hot air through the oven or processing chamber, and add such heat to the recirculating stream as is necessary to maintain the desired air temperature. In most such installations it is necessary to add fresh air continuously to the circulating atmosphere of the oven, and to exhaust a corresponding amount of such atmosphere by a suitable stack or fan, in order to provide necessary ventilation and avoid build-up of explosive or combustible gaseous mixtures within the oven. For heating economy, however, the amount of ventilating air added to the recirculating stream is held to a minimum, and may be of the order of 20% of the recirculating stream. The necessary heat is commonly supplied to the recirculating stream by operating burners such as line burners in the recirculating stream itself.

In the recirculating stream, the "air" or oven atmosphere is not normal air but is mixed with quantities of various gases such as excess nitrogen, carbon dioxide, water vapor, etc., resulting from the oven processes and the combustion in the recirculating stream and from the

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continuous recirculation with only small amounts of added ventilation air. Accordingly, the "air" stream is deficient in oxygen, and the oxygen-lean air is not well suited to good combustion requirements. As noted above, the "air" and "air stream," we mean to include both normal air and other atmospheres in which a gas burner is operated.

Until fairly recently, it was considered necessary in order to obtain clean and complete combustion of the fuel for this heating application that all or substantially all of the air required for combustion be supplied from outside the oven as by means of an external blower. Moreover, the available burners have provided a turn-down ratio of not more than about 4-to-1 or 5-to-1.

More recently, efforts have been made to reduce the amount of outside air required for combustion and to utilize substantial percentages of combustion air from the recirculating stream, in order to reduce or eliminate the external blower requirements and to reduce the expense of installation and operation of the burner system. But these attempts depend largely or entirely on the oxygen-lean atmosphere of the oven to supply the oxygen for combustion have frequently resulted in poor quality of combustion. In many cases, incomplete burning of the gas has resulted in damage to the product from fumes or from free carbon deposited as soot. The basic cause of these difficulties has been an inadequate intermixing of the gas fuel with the oxygen-lean atmosphere of the oven.

It is one of the objects of our invention to provide a burner in which greatly improved intermixing is obtained between the gaseous fuel and "air" from the recirculating oven atmosphere, thereby securing a more effective utilization of the oxygen in that oxygen-lean atmosphere. Burners embodying the invention can obtain complete and immediate combustion of gaseous fuel in oven installations, using the oven atmosphere to supply high proportions or even the entire amount of oxygen required for combustion. The requirements for the external air are thus reduced or avoided, and external blowers can be smaller or eliminated entirely. Our new burners operate in higher air stream velocities, thus permitting smaller duct sizes. Our burners may use air stream flow not only to cause intermixing of air-gas mixtures with secondary air, but in certain cases can use such flow to induce intermixing flow of gas and primary air.

Further, the invention provides high turn-down ratios in oven applications, and while we can go higher, in such applications we may use burner forms providing ratios ranging up to about 15-to-1. This is substantially higher than previously available and is highly beneficial, for example, in eliminating over-riding of temperatures during periods of low demand while providing higher speed in bringing the installation up to operating temperatures.

Ill. Heating air in simple non-recirculating drying applications.—In grain dryers and other simple applications for heating, dehydrating, and the like, a gas burner is operated in an air supply duct in a relatively simple system where the primary need is a simple, inexpensive, and reliable burner which gives large heat inputs in a duct system of reasonable size. The principal difficulty with burners heretofore used is excessive flame length from the burners, which makes it necessary to use long ducts and may cause damage by spot heating of duct work and fans.

Particularly in these simple applications, as well as in most other applications, our new burners are especially advantageous in their unique ability to intermix larger quantities of fresh air more completely at the face of the burner, and to burn with a much shorter flame length than prior burners; and to do so at high heat input rates and in high air velocities.

As illustrated above, our invention has as a principal object the provision of a gas burner having improved mixing means for intermixing gas and air at the face of the burner, and for doing so at varying rates of operation. It is a further principal object of the invention to provide a gas burner which is especially applicable for operation in an air stream to heat the air of such stream, and which has a number of advantages and improved characteristics as compared to burners previously available for air stream applications, including such advantages and characteristics as the following:

(1) Increased capacity with clean, intense, and complete combustion, and short flame length, over a range of heat inputs (for a given size burner) extending substantially above that available from prior burners. For example, where prior line burners in air stream operation have a maximum output not exceeding 200,000 B.t.u. per hour per lineal foot of burner, when operating in a restricted range of air velocities of 500 to 1,500 feet per minute, outputs of our new burner run up to and beyond 500,000 B.t.u. per hour per foot, in air velocities ranging up to 4,000 feet per minute.

(2) Positive flame retention and stable combustion at higher heat inputs and in higher velocity air streams. For example, where prior line burners even for limited outputs require air velocities to be held at or below 1,500 feet per minute and fuel mixture pressures to be held within restricted limits, to avoid flame loss, our new burners avoid these limitations and operate satisfactorily at higher and wider ranges of outputs in air velocities from 1,500 to 4,000 feet per minute. In contrast to prior burners, the output of our burners is not limited by danger of flame loss.

(3) Utilization of the air stream to supply large proportions or all of the air required for combustion, and to produce intermixing of air and gas, which substantially reduces the amount, complexity, and cost of air supply means otherwise required.

(4) Operating flexibility, that is, ability to operate satisfactorily over a substantial range or variation of operating conditions, and consequent high tolerance for different air velocities, for turbulence, and for non-uniformity in the air stream, and high tolerance for variations in air-fuel ratios and in B.t.u. content of the gases used.

(5) A high turn-down ratio, and ability to be throttled or adjusted with smooth continuous variation of heat output over a broad range of operation. Thus, where prior air-stream burners had turn-down ratios not exceeding 10-to-1 and greater turn-down requirements could be met only by expensive multiple systems giving uneven control, our new burners have turn-down ratios running well beyond 25-to-1 and give smooth and continuous control over the whole range.

(6) Various other and additional advantages as will appear from the description of the invention and burner apparatus embodying the same.

Apparatus is known for supplying gas burning equipment with pre-mixed gas and air and for controlling and adjusting both the amount of mixture and the proportions of air and gas supplied, as of the type shown in Patents Nos. 2,035,904 and 2,286,173. We may use such control and adjusting apparatus to supply different gas-air fuel mixtures for different stages of operation of our new burners in high turn-down installations.

In accordance with the invention, a gas burner may comprise an open-faced combustion and mixing space in which a standing pattern or array of spaced air jets is provided adjacent a gas supply means and extending laterally therefrom, preferably with near jets of relatively small capacity and relatively widely spaced and with more remote jets of greater capacity and less widely spaced, and desirably with the jets directed at a converging angle with respect to the direction of gas discharge. The air jets induce reduced pressure in the spaces or passageways between the jets of the standing pattern, which draws gas into and through such spaces and passageway and into admixture with air of the jets to form a rapidly and completely combustible mixture which will burn about the jets and in the said combustion space, the combustion extending to and involving a greater or lesser portion of the air jets pattern depending upon the amount of gas supplied. Preferably, the air jets are formed at opposite sides

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of the gas supply means and are arranged to converge or interlace in the space toward which the gas supply means discharges. The air jets may thus form a converging curtain or canopy over the gas supply to ensure thorough mixing and heating and combustion of all the gas supplied at all rates of operation.

The gas supply means desirably comprises one or more gas ports in a nozzle of along a manifold, and this is desirably flanked by one or more mixing walls or plates having a pattern of air openings at which air jets are caused to form by a suitably induced pressure differential across the mixing wall or walls. A symmetrical arrangement of mixing walls is preferably used, as by disposing walls at opposite sides of the gas supply means. The air jets may be directed into convergence with the gas flow and each other by disposing opposite mixing walls in facing divergent relation in the direction of gas flow and disposing the air openings in converging directions through the divergent mixing walls.

In air stream applications, one or more mixing walls or plates is positioned to present one side thereof to the air flow in the air stream and to set off or define a mixing area and combustion space on the downstream side thereof in which the air stream flow induces a reduced pressure or partial vacuum. The walls are provided with air-admitting openings, preferably associated with air-directing means, through which the air jets are caused to issue by reason of the impingement of the higher pressure air stream at the back of the walls and the presence of the reduced pressure at the front face of the walls. The burner thus utilizes the air stream itself both to provide the operating pressure conditions and to supply the air for the air jets and the combustion which occurs therewith.

The mixing walls preferably lie oblique to the air flow path and, as shown in the accompanying drawings, desirably diverge at an included angle of 50°. Such walls set off a combustion space which is open in the direction of air stream flow and which is desirably of progressively increasing cross-sectional area in such direction. The pattern of spaced air-admitting openings in such wall or walls is desirably of progressively increasing area in the direction of increasing cross-section of the combustion chamber, and the web areas between the openings and underlying the passageways between the air jets are desirably wider at the inner portion of the walls, so that the gas passageways are of larger capacity in such inner portion.

Combustion chambers may be of various cross-sectional shapes. For example, the burner may have a conical or pyramidal combustion chamber of circular, rectangular, or other cross-section. In line burners the combustion chamber is preferably a deep wedge-shaped trough formed by diverging side walls having spaced rows of spaced openings formed therein. Desirably, the openings at the bottom or innermost portion of the trough are smaller and more widely spaced while the outer rows are larger and have less walls area between them. The air openings are less than sufficient to satisfy the vacuum produced within the mixing chamber, e.g. the trough, by the air flow, and are spaced sufficiently to provide adequate gas flow passages between the air jets issuing through such openings. The height of the walls and the number of rows of openings may differ for different burner capacities and different ranges of turn-down ratio.

Baffles or deflectors are desirably provided outside the air openings to deflect air therethrough from the air stream and to direct the air jets inward from the face of the mixing wall. These can be formed in any suitable way, depending on the material used. In sheet metal mixing plates, the deflectors are desirably provided by bending or deforming portions of the sheet metal outward from the mixing wall to form the air openings and leaving such portions in out-standing position as in the form of tongues at the downstream edges of the openings.

The nozzles, manifolds, mixing plates or walls, and other parts of the burner may be made from any suitable material or materials, such for example, as heat-resistant sheet-metal, coated metals, ceramics, and other materials capable of withstanding the temperatures and other operating conditions of the particular installations for which the burners are intended.

The fuel supply means for the burner preferably introduces gaseous fuel (gas-air mixtures or raw gas) into the mixing chamber at its closed upstream end, i.e. at the bottom of the trough of a line burner. Some of such gas will intermix with the converging or inter-lacing air jets. Other portions of the gas will be drawn into and along the low-pressure passageways between the air jets and is drawn therefrom into admixture with the air of such jets, to burn rapidly and cleanly in intense flame at the surfaces of the jets and between them. The number of jets at which flame appears and the amount of flame in the combustion chamber will vary with the amount of gas supplied. By varying the amount of gas or gas-air fuel mixture supplied to the burner, and desirably varying also the proportion of gas in the gas-air mixtures used, the rate of operation and the heat output can be smoothly and continuously varied over a substantial range running upward to very high outputs.

In a wide turn-down ratio burner embodying the invention, the fuel supply means combined with the mixing walls and combustion chamber described above is desirably in the form of a burner element which in combination with the parts described above will itself operate over a range of low input rates, with the mixing walls serving, during low fire conditions, to protect the low fire from the air stream and, at higher rates, to provide the high capacity and complete combustion as described above. To this end, the gas discharge means at the bottom or base of the mixing chamber is desirably in the form of one or more main gas ports, flanked by shielded eddy pockets supplied by supplementary or ignitor gas ports which may be of smaller capacity than the main gas ports.

In a wide turn-down ratio burner, such as a line burner, the various stages and variations of operation may be as follows:

For minimum and low rates of operation, the burner ports may be supplied with a combustible mixture of gas and air containing all or substantially all the air required for combustion, and at a low rate sufficient to avoid flash back. Under such supply conditions, only a low fire will be produced, such as small flame cones at the main burner ports, and such low fire will be contained in the bottom of the mixing trough, below at least most of the air jets, and will be protected from the high velocity air stream by the mixing walls. For progressively higher stages of operation, the amount of fuel mixture supplied is progressively increased. As this occurs, the fuel jets issuing from the main ports will reach a velocity at which flame retention might be lost if such main ports stood alone; but the gas supplied through the ignitor ports to the shielded eddy pockets alongside the main ports will be slowed and will maintain stable ignitor flame at the base of the gas jets from the main ports, and will constantly ignite those main gas jets. The low-capacity element of a line burner embodying the features described might itself be operated, in a typical case, at a minimum of about 12,000 to 15,000 B.t.u. per lineal foot per hour and upward therefrom over a considerable range, with stable flame and no danger of flame loss.

However, as the supply rate of air-gas mixture is increased in the high turn-down ratio burner, to increase the operating rate, the gas-air mixture supplied to the burner is desirably progressively enriched by increasing the proportion of gas therein. With such richer mixtures, while flame may continue at the main gas ports, unburned gas will flow therefrom to the low-pressure passageways between the air jets and will be drawn into

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the jets and burned with air from such jets. As this action progressively occurs, flame streaks or cones will progressively appear at the innermost air openings.

For still higher-rate operation, the amount of air-gas mixture and the proportion of gas therein are further progressively increased. With such increase, the appearance of flames associated with the main gas ports of the low-rate element becomes progressively less clear, and a stage is reached at which the main and supplementary gas ports combine to serve wholly as gas supply passages rather than as burner nozzles, and to fill the bottom of the combustion trough with unburned gas mixture. While such gas mixture may still have substantial velocity toward the open face of the burner and part of it will mix and burn with the converging air jets, much or most of it will be drawn laterally to the faces of the mixing plates and there into and along the low-pressure passageways around and between the air jets. The induction effect of the air jets will cause thorough mixing of the gas with air from the air jets, and combustion will take place mainly about such jets and in the space to which they discharge, with well defined flame cones appearing at the air openings. As the supply of fuel is still further increased and richened—or changed to raw gas—flame will appear at more air jets and at jets farther toward the open mouth of the trough, and the flame may fill the trough to an increasing extent and stand outward from its mouth. This operation, in a typical line burner embodying the invention may give outputs ranging upward to 500,000 B.t.u. per lineal foot per hour. Since the same burner at the low-rate operation described above has an output of 12,000 to 15,000 B.t.u. per foot per hour, the burner gives a turn-down ratio well above 25-to-1.

Moreover, the burner combination operates at any B.t.u. input in the entire range of operating rates with considerable variation in gas-to-air proportions in the fuel mixture supplied; and this is especially so, and especially advantageous, at upper-stages of operation. Thus in operation at high capacities, the fuel mixture supplied to the burner can vary from raw fuel gas to a pre-mixed gas-air mixture containing large proportions, say up to 50%, of the air required for combustion. Clean combustion can be obtained at any desired B.t.u. output with a considerable variation of air-fuel ratios and operating conditions and without need for critical adjustment. The burner utilizes the flow of the air stream to produce complete intermixing of all the gas with air, and this action is self-regulating and automatically compensates for variations in supply rates and richness or leanness of fuel mixtures and air mixtures.

With such flexible and self-compensating operation at any point in the operating range, it is readily possible to throttle the burner over a broad range of heats inputs and to obtain continuous smooth variation in output over the entire broad range of operation.

The accompanying drawings illustrate the invention. In such drawings:

FIG. 1 is a somewhat diagrammatic sectional view of an air-heating installation using a line burner assembly embodying the invention, with the burner supplied from a pre-mixing blower and proportioning valve, which installation may be considered a fresh air application by assuming the incoming air to be fresh air, or a recirculating oven atmosphere application by assuming the air stream to be part of a recirculation stream.

FIG. 2 is a somewhat diagrammatic section taken on the line 2—2 of FIG. 1, showing a front elevation of the line burner assembly;

FIG. 3 is a sectional view of a burner embodying both the high capacity and high turn-down aspects of the invention, taken on the line 3—3 of FIG. 2;

FIG. 4 is a diagrammatic view showing the apparatus of FIGS. 1-2 in a fresh air application;

FIG. 5 is a pictorial view of a burner unit as shown in FIG. 3, with parts broken away for clarity, and with air and gas flow indicated thereon;

FIGS. 6, 7, and 8 are sectional views similar to FIG. 3, in which high, intermediate, and lower stages of operation are indicated;

FIG. 9 is a cross-sectional view similar to that of FIG. 3, showing a modified burner unit having mixing walls of reduced height; and

FIG. 10 is a pictorial view of a T-shaped burner section embodying the invention, and provided with relatively short side walls as in FIG. 9.

The air-heating apparatus shown in FIG. 1 is illustrative of arrangements in which an air stream flowing through a duct 14 is heated by a line burner assembly 20. The air stream may be either a fresh air stream, as where the duct 14 is one connected to a fresh air inlet grill 13 as shown in FIG. 4; or the air stream may be a recirculating stream, as where the duct 14 is part of the recirculating duct work of an industrial oven or the like. The air stream will be propelled through the duct 14 by a suitable blower such as the blower 15 shown in FIG. 4, and in different installations the burner 20 may be either on the upstream or suction side of the blower or on the downstream or pressure side of the blower.

In the arrangement shown in FIG. 1, a gas burner assembly 20 is arranged transversely of the duct 14 and is connected to a supply line 22 leading from a blower-mixer 24 of the type shown in U.S. Patent No. 2,035,904. Such mixer has a gas inlet pipe 23 and an air inlet shutter 25, and is arranged not only to supply regulated amounts of gas-air mixture, but also to control the proportions of gas and air in the mixture and to provide different proportions in the mixture at different rates of mixture supply. The gas-air proportions are controlled by suitable fixed adjustments in the mixer 24, and the rate of mixture supply is controlled by a controller 26 responsive to a thermostat 27 positioned at a suitable control point in the air system.

As indicated in FIG. 2, the burner assembly 20 is made up of line burner elements or units forming a pattern which is distributed transversely across the area of the duct 14. The heating flame occurs in a substantially continuous line along the length of each burner unit, and the assembly shown distributes the flame and heat in a desirable pattern across the whole air stream. Several shapes of the burner units may be used to form burner assemblies. In the assembly shown, the center unit is a cross-shaped unit 30, provided with bottom inlet 32 for connection to the supply line 22. The upper and lower arms of the cross unit 30 are connected to straight units 34, and these are connected to T-shaped units 36. The horizontal arms of the center cross unit 30 are connected to similar cross units 38, having no bottom inlets, and the upper and lower arms of each such cross unit 38 are connected to straight units 34. The free ends of the burner units are closed by suitable end plates 40.

FIGS. 3 and 5 show details of the burner units, as embodied in a straight unit 34. The burner unit comprises a manifold section 50 forming a gas conduit, and having attachment flanges 52 at its ends. At one side, here shown at the top, the manifold section 50 is formed as a flat wall 54; having a longitudinal ridge or rail 56 along each edge. The other walls are desirably rounded to present a streamlined shape to the air stream. A row of main burner ports 58 is arranged longitudinally along the center of the flat wall 54. Two rows of supplemental or ignitor ports 60 are formed in the flat wall 54, between the row of main burner ports 58 and the rails 56. Such ignitor ports 60 may be of smaller size than the main ports 58, and are desirably positioned in staggered relation with the main ports 58. A shielding and mixing plate or wall 64 is mounted on each longitudinal ridge 56. Each such plate 64 comprises a flat bottom wall 66 resting on the ridge 56 and extending inward therefrom, with an up-turned lip or flange 68 at its inner edge.

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Such bottom walls 66 desirably extend inward beyond the ignitor ports 60 but short of the main ports 58. Their lips 68 are spaced from each other to form a slot through which the main ports 58 are exposed and through which the gas jets fom the ports 58 may pass. The ridges 56 and the inward extending parts of the walls 66 form eddy pockets 62 at opposite sides of the gas jets from the main ports 58, at the base of those jets.

From the outer edge of the bottom wall 66, the shield 64 extends straight upward to form a flame shield 70, and from the upper end of such shield extends obliquely outward to form a mixing wall 72. Each mixing wall 72 contains a plurality of rows of spaced air-admitting apertures, desirably of progressively increasing size and in staggered relation. As shown, the mixing wall 72 contains a bottom row of relatively small apertures 74, a second row of intermediate sized apertures 76, and third and fourth rows of larger apertures 78 and 80. Various forms of apertures can be used. In the preferred form shown, each aperture is rectangular and is formed by striking outward from the mixing wall a tongue of metal, and such tongues are desirably left as outward projections, standing substantially normal to the wall 72, to deflect air through the apertures from the air stream in which the burner is located. On the outer face of the mixing wall, therefore, there are a series of small tongues 75 at the upper edge of the small apertures 74, and similar tongues 77, 79, and 81 at the upper edges of the apertures 76, 18, and 80. The four rows of tongues extend progressively farther outward into the air stream, both by reason of the oblique position of the wall 72 with respect to the air stream and by reason of their progressively greater lengths. The ends of the plates 64 are desirably provided with stiffening flanges 63 through which bolts or rivets may be passed to interconnect the plates of adjacent burner sections.

The burner shown in FIG. 3 may operate in any desired position. Thus, it may face upward as shown in FIG. 3, or it may face horizontally, either with its longitudinal axis vertical as in the vertical sections of the burner assembly shown in FIG. 2, or with its longitudinal axis horizontal and with its gas ports 58 disposed in a horizontal plane as in the horizontal portions of the burner assembly shown in FIG. 2. In any case, the burner unit will be disposed in a fast-moving air stream, which may be flowing at velocities of 1,500 to 4,000 feet per minute. The air flow will be in the direction indicated by the arrows appearing in FIGS. 1 and 3. The air will approach the burner unit from the back side of the manifold 50 and will flow along the side walls of such manifold and forward along the outer faces of the shielding and mixing plates 64. The open mouth 65 of the mixing trough and combustion chamber formed by the plates 64 will face downstream in the direction of air flow. Air stream flow past the burner will create a low pressure or vacuum in the mixing trough of the burner. Such vacuum, plus the ram effect of the air at the apertures 74, 76, 78, and 80, and the deflection of air thereto by the tongues 75, 77, 79, and 81, will cause jets of air to issue obliquely inward from the apertures, as indicated by dotted lines in FIG. 5. These jets will be insufficient to satisfy the vacuum within the mixing chamber; moreover they will themselves induce low pressure in the areas around and between the jets and adjacent the inner faces of the mixing wall 72. These low pressure areas between the jets will provide flow paths into which gas issuing from the manifold will be drawn and along which gas will flow when the gas is not completely consumed in flames at the gas ports and unburned gas is present in sufficient quantities to permit that flow to occur. The gas flow in such low pressure areas, as indicated by the arrows in FIG. 5 can carry gas to all the air jets issuing through the mixing wall 64.

With these conditions of air flow and pressure, a wide variety of operating conditions can be obtained under relatively simple regulation of the amount and character of fuel gas mixture supplied through the manifold.

FIGS. 6, 7, and 8 illustrate three stages of operation. In such figures, the air jets A are shown in full lines, unburned or incompletely burned gas G is indicated by stippling, and flame is indicated by dotted lines. At all stages, a pattern of air jets A will stand inward from the air apertures 74, 76, 78, and 80, to be involved in combustion to a greater or lesser extent depending on the gas supply rate.

For the high fire operation indicated in FIG. 6, the manifold 50 carries either raw gas or a rich gas-air mixture, containing up to say 20% of the air required for combustion. The gas supply rate will be high, as at a pressure of 6 inches of water column, and the gas ports 58 and 60 will serve in common to supply gas to and through the slot between the lips 68 at the bottom of the mixing trough. Part of the gas will flow centrally into admixture with the converging air jets, as indicated by the central stippled area at the base of the trough. Substantial other portions of the gas will flow laterally toward the mixing walls 72, its velocity will be reduced and it will be drawn toward the mixing walls 72 by reason of the low pressure areas existing adjacent those walls and in the spaces between the air jets A issuing from the apertures 74–80. The gas will flow in the low pressure flow paths (as indicated by arrows in FIG. 5) to surround such air jets and to mix with them. As a result, a mass of flame will occur in the mixing trough and projecting therefrom, as generally indicated in FIG. 6. The gas mixing with the air jets will burn at the surfaces of the jets to form distinct flame streaks standing inward from the air openings 74–80, at the surfaces of the air jets, and further combustion will occur between and around the jets. The central portion of the mixing trough will be filled with a mass of burning gases, which flame may project some distance from the open mouth of the burner trough, say up to two or three times the width of the open mouth of the trough. The combustion is intense and clean, and the flame is firmly seated and anchored in the burner trough, with no tendency to drift or blow away from the burner. This stage of operation provides very high rates of heat input into the air stream in which the burner is operated.

At the low stage of operation indicated in FIG. 8, the combustion is substantially independent of the air jets issuing through the air openings 74–80; but the air jets serve to carry the products of combustion into the admixture with the air stream, the mixing trough provides desirable pressure conditions about the flame, and the side plates 64 of the burner assembly serve effectively to shield the flame from the fast-moving air stream. For this low stage of operation the gas-air mixture supplied to the manifold 50 desirably contains all or substantially all of the air required for combustion, say 80 or 90% of the combustion air. The air-gas mixture is supplied at relatively low pressure, as of the order of one-half to one-fourth inch of water column. Under these conditions, the fuel mixture issuing through the main ports 58 forms distinct flame cones 59 at each of the main ports 58. Such cones will be closely embraced by the lips 68 which form eddy pockets 62 along both sides of the row of gas jets from the main ports 58. The gas issuing from the ignitor ports 60 will be slowed in the eddy pockets 62 and will burn in tongues of flame 61 which fill the slot formed by the lips 68 at points between the main flame cones 59. These ignitor flames 61 will be maintained at the base of the fuel jets issuing from the main ports 58, and will constantly ignite those main jets and will ensure flame retention.

The rate of combustion in this low stage of operation may be adjusted over a considerable range. At a minimum, the flame may consist of a short continuous line of flame along the slot between the lips 68, with only small enlargements appearing at the main ports 58. At

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higher rates, the flame cones 59 at the main ports 58 may extend a substantial distance outward in the trough of the burner assembly. The jet velocity from the main ports may be well beyond that at which flame could otherwise be retained, but the eddy pocket construction and the ignitor flame at the base of such jets will constantly ignite them and main ain stable combustion.

At intermediate stages of operation, low-stage and high-stage conditions smoothly merge with each other in varying amounts. A typical intermediate stage of operation is shown in FIG. 7 to illustrate such merging. The manifold is supplied with an air-gas mixture containing 50 to 60% of the total air required for combustion. The jets of gas-air mixture from the main ports 58 are of high velocity, but are continuously ignited by ignitor flames opposite the ignitor ports 60 at the lips 68, and distinct central flame cones appear opposite each main port 58. Less than all of the fuel is consumed in these flames, and combustible gas flows to the low pressure areas between the air jets issuing from the apertures in the mixing walls 72, and is drawn into such jets and burned with air from them. Distinct flame cones appear at the innermost air openings 74, and partial flame cones appear at the air openings 76.

As the amount and richness of the gas-air mixture is increased from the conditions of FIG. 7, combustion will progressively change toward the high stage of operation shown in FIG. 6, with progressively less flame in the bottom of the trough and with more at and about the air jets. As the amount and richness of the air-gas mixture is decreased from the interme hate stage of FIG. 7, the character of operation will approach that of FIG. 8.

While different stages of operation have been illustrated and described, these are but points in a smoothly and continuously adjustable range of operation from minimum to maximum. The burner is preferably used with a proportioning control device which regulates the total supply of admixed gas and primary air, and which will also vary the proportion of air mixed with the fuel gas, such as a control device of the type shown in U.S. Patent No. 2,286,173. With a control of this type, the burner can be smoothly throttled over the whole range of operation from the very high rate of maximum high-stage operation down to the lowest rate of low-stage operation.

FIG. 9 shows a burner unit which may be used where a lower maximum B.t.u. input is required than that provided by the unit of FIGS. 3 and 5. The manifold 50 of the unit in FIG. 9 is identical with the manifold of the unit of FIG. 3, save that the gas ports may be of smaller size. The side plates 164 of the burner are identical with the plates 64 shown in FIGS. 3 and 5 and described above, save that they are only half as high and contain only two rows of air apertures 174 and 176, instead of the four rows shown in FIG. 3.

FIG. 10 shows a T-shaped section equipped with mixing plates of the same height as those in FIG. 9. The arms of the T-shaped manifold 150 have the same cross-sectional configuration as shown in FIGS. 3 and 9, with a flat wall 154 containing longitudinal rows of main and ignitor gas ports, and having longitudinal ridges or rails 156 along its edges. The cross arm 151 of the T-shaped unit carries at one side a straight side plate 164 like that shown in FIG. 9. The adjoining rails 155 of the cross arm 151 and the center arm 153 carry side plates 163 which in cross-section are the same as shown in FIG. 9 but which are L-shaped in plan. These form wedge-shaped troughs, above the arms of the T-shaped unit, of the same configuration as in FIG. 9, and in open communication with each other.

FIG. 10 illustrates elements which are used in the construction of cross-shaped and T-shaped burner sections such as those of the burner assembly shown in FIG. 2. It will be understood that such burner sections may be equipped either with full-height side plates as shown in FIG. 3 or with the half-height side plates shown in FIGS. 9 and 10.

In the drawings illustrating the invention, it will be noted that certain relationships are shown. Referring, for example, to the preferred modification shown in FIGS. 1, 2, 3 and 5, the mixing plates 64 define at their forward edges a discharge opening or mouth 65 for the mixing space of the burner which is substantially coextensive with the frontal area of the burner. As shown in FIG. 2, such discharge opening of the burner 20 lies within the cross section of the air stream passage defined by the duct 14, leaving a surrounding open area of the air stream passage which is larger and of greater capacity than such discharge opening. By measurement, FIG. 2 shows an open air stream passage within the duct 14 greater than the frontal area of the burner 20.

In FIGS. 3 and 5, it may be noted that the area of each mixing wall 72, extending obliquely outward from the straight flame shield 70, is shorter and of smaller area than the width and area of the open mouth 65 between the outer edges of the mixing walls 72—the top edges in FIG. 3—and hence of less area than such open mouth 65 or discharge area defined between such outer edges. Further, it is clear that the various apertures 74, 76, 78 and 80 in such mixing walls 72 are of substantially smaller area than the wall portions between them, and from this it is evident that the apertures provide a total inlet area to the mixing space which is substantially smaller and of less capacity than the discharge area of such open mouth 65. Further, in the duct installation shown in FIGS. 1 and 2 the mixing space inlet area, being smaller than the burner outlet area, is also smaller and of less capacity than the air stream passage provided by the surrounding open duct area. Similar relationships are present in the other modifications shown in the drawings.

We claim as our invention:

1. A high turn-down gas burner adapted for operation in an air stream flowing forwardly past the burner at a velocity of the order of 1500 to 4000 feet per minute, comprising an elongated burner body defining a fuel gas supply passage and having an elongated forward wall to lie transversely of the direction of the air stream, said wall having gas port means at a series of points along its length, flame shielding walls extending forward from adjacent the sides of the body in spaced relation along opposite sides of said gas port means, defining a low-flame zone in front of said gas port means, mixing plate walls extending obliquely forward and outward from said shielding walls in divergent relation at an included angle of the order of 50°, said walls defining a forwardly widening trough-shaped mixing space forwardly of said gas port means, said mixing space being forwardly wide open for free and open discharge communication with the passing air stream, said mixing plate walls projecting laterally of said burner body with their back faces positioned to lie exposed to the air stream flowing past the burner, a plurality of apertures in said mixing plate walls spaced both longitudinally thereof and at different distances from said burner body, said apertures being smaller than the wall areas between the same and having a total area substantially less than the forward open discharge area of said mixing space, the inner apertures being of smaller capacity than the outer apertures, air deflector means projecting obliquely outward and rearward into the path of the passing air stream from adjacent the down stream edges of said apertures, said burner body and divergent walls being shaped to divide and outwardly deflect the air stream flowing past the burner and cause such flow to create reduced pressure in said mixing space, and said apertures and deflector means being positioned and arranged to admit and direct air from such passing air stream into the mixing space in distinct jets flowing obliquely forward and inward in said mixing space in front of said low-flame zone, said gas port means being

operable to discharge variable amounts of fuel gas from said burner body to said low-flame zone and mixing space whereby to provide low flame combustion in said zone and progressively higher flame combustion involving progressively more of the spaced air jets in said mixing space.

2. Air stream heating means having a high turn-down ratio, comprising an elongated burner body defining a gas supply passage and having a forward wall, gas port means at a series of points along said forward wall including high and low velocity gas ports and forming a variable-rate gas burner when supplied with varied amounts of combustible air-fuel mixtures, means for forming an air stream flowing forwardly past the burner at a velocity of the order of 1500 to 4000 feet per minute, shielding walls extending forward from said body on opposite sides of said gas port means and shielding the same from the passing air stream, mixing plates extending divergently forward and outward from said shielding walls at an included angle of the order of 30°, defining a trough-shaped mixing space in front of said variable rate burner, said mixing plates being exposed to the passing air stream and arranged to cause the same to produce reduced pressure in said mixing space, means including spaced apertures in said mixing plates to cause a standing array of spaced jets of air from said passing air stream to issue inward and forward in converging relation in said mixing space forwardly of said variable rate gas burner, and supply means to supply controlled amounts of air and fuel gas to said gas supply passage for discharge from said gas port means, said supply means at low rate deliveries supplying a substantially combustible air fuel mixture for shielded combustion at said port means, and at higher rate deliveries supplying progressively richer gas mixtures to progressively involve in combustion the standing array of air jets in said mixing space whereby said burner may be adjusted in operation from a high rate involving combustion at substantially all said air jets down to a low rate of combustion at said port means and inward of said array of air jets.

1. A high turn-down ratio gas burner for operation in and for heating a low-pressure air stream flowing forward past the burner at a velocity of the order of 1500 to 4000 feet per minute, comprising in combination, an elongated burner body having means for connection to a supply of gas-air mixtures and defining a feed passage and having a forward wall, means including gas port means connected to said passage for forming along said forward wall a variable low-rate burner for variable low-rate combustion of combustible air-gas mixtures independently of air from the passing air stream and operable over a substantial turn-down range when supplied at varied rates with combustible air-gas mixtures, shielding wall means connected to said burner body and extending forward in laterally spaced relation from opposite sides of said variable low-rate burner, said wall means defining in front of said variable low-rate burner a shielded zone in which said variable low-rate combustion can take place independently of and shielded from the passing air stream and in which at higher combustion rates fuel gas can flow forwardly from said gas port means, mixing plates extending obliquely forward and outward from said shielding walls in widely divergent relation and defining at the front thereof a forwardly widening mixing space in open receptive communication with said shielded zone and having an open discharge at its forward end, said mixing plates being arranged for exposure to the air stream and for shielding said mixing space therefrom, means including a plurality of spaced rows of spaced apertures in said mixing plates for admitting jets of limited quantities of air from the passing air stream into said mixing space, said aperture-including means and the angular position of said mixing plates being arranged to cause said jets to stand in forwardly converging arrays of spaced jets, said apertures being of limited capacity and having a total area substantially less than the forward open discharge end of the mixing space between the plates, the apertures at the inner portion of the mixing space, adjacent said shielded zone, being relatively small and being proportioned to cooperate with said variable low-rate burner to provide air for progressively increased combustion, in said zone and inner mixing-space portion, of gas-rich air-fuel mixtures supplied through said port means, the apertures at outer portions of said mixing space being larger and being proportioned to supply additional air for progressively higher rate combustion in said mixing space of gas-rich fuel supplied thereto through said port means and said low-rate zone, whereby said burner may be adjusted in operation from a high rate involving combustion at substantially all said air jets, through substantially continuous variation, down to a low rate of combustion at said low-rate burner inwardly of said air jets.

4. Air stream heating apparatus according to claim 3 in which said mixing plates lie at an included angle of the order of 30 degrees, said angled position serving to promote the action of the passing air stream in producing reducing pressure and converging air jets in said mixing space and to promote cool operation of the mixing walls.

5. Air stream heating apparatus according to claim 3 with the addition of deflector means standing outward into the passing air stream from adjacent the forward edges of the apertures for directing and increasing the force of the air jets produced in the mixing space by the flow of the air stream against and past the burner.

6. A high turn-down ratio gas burner as defined in claim 3 in which said gas port means comprises central main gas ports at a series of points along said forward wall and supplemental gas port means in flanking relation with said main gas port means, and said low-rate burner comprises flange means in spaced overlying relation with said supplemental gas port means and defining a flame-retention opening aligned with said main gas port means and offset from said supplemental gas port means, and said shielding wall means comprises opposite walls extending forward from points spaced laterally from said flame-retention opening.

7. A high turn-down ratio gas burner for operation in and for heating a low-pressure air stream flowing forward past the burner at a velocity of the order of 1500 to 4000 feet per minute, comprising in combination, a burner body having means for connection to a supply of gas-air mixtures and having forward gas port means and flame-retention means cooperating therewith to form a variable low-rate burner for variable low-rate combustion of combustible air-gas mixtures independently of air from the passing air stream and operable over a substantial turn-down range when supplied at varied rates with combustible air-gas mixtures, shielding wall means connected to said burner body and extending forward in spaced relation to define in front of said variable low-rate burner a shielded zone in which said variable low-rate combustion can take place independently of and shielded from the passing air stream and in which at higher combustion rates fuel gas can flow forwardly from said gas port means, mixing plates extending obliquely forward and outward from said shielding walls in widely divergent relation and defining at the front thereof a forwardly widening mixing space in open receptive communication with said shielded zone and having an open discharge at its forward end, said mixing plates being arranged for exposure to the air stream and for shielding said mixing space therefrom, means including a plurality of spaced rows of spaced apertures in said mixing plates for admitting jets of limited quantities of air from the passing air stream into said mixing space, said aperture-including means and the angular position of said mixing plants being arranged to cause said jets to stand in spaced forwardly converging relation, said apertures being of limited capacity and having a total area substantially less than the forward open discharge end of the mixing space between the plates, the apertures at the inner

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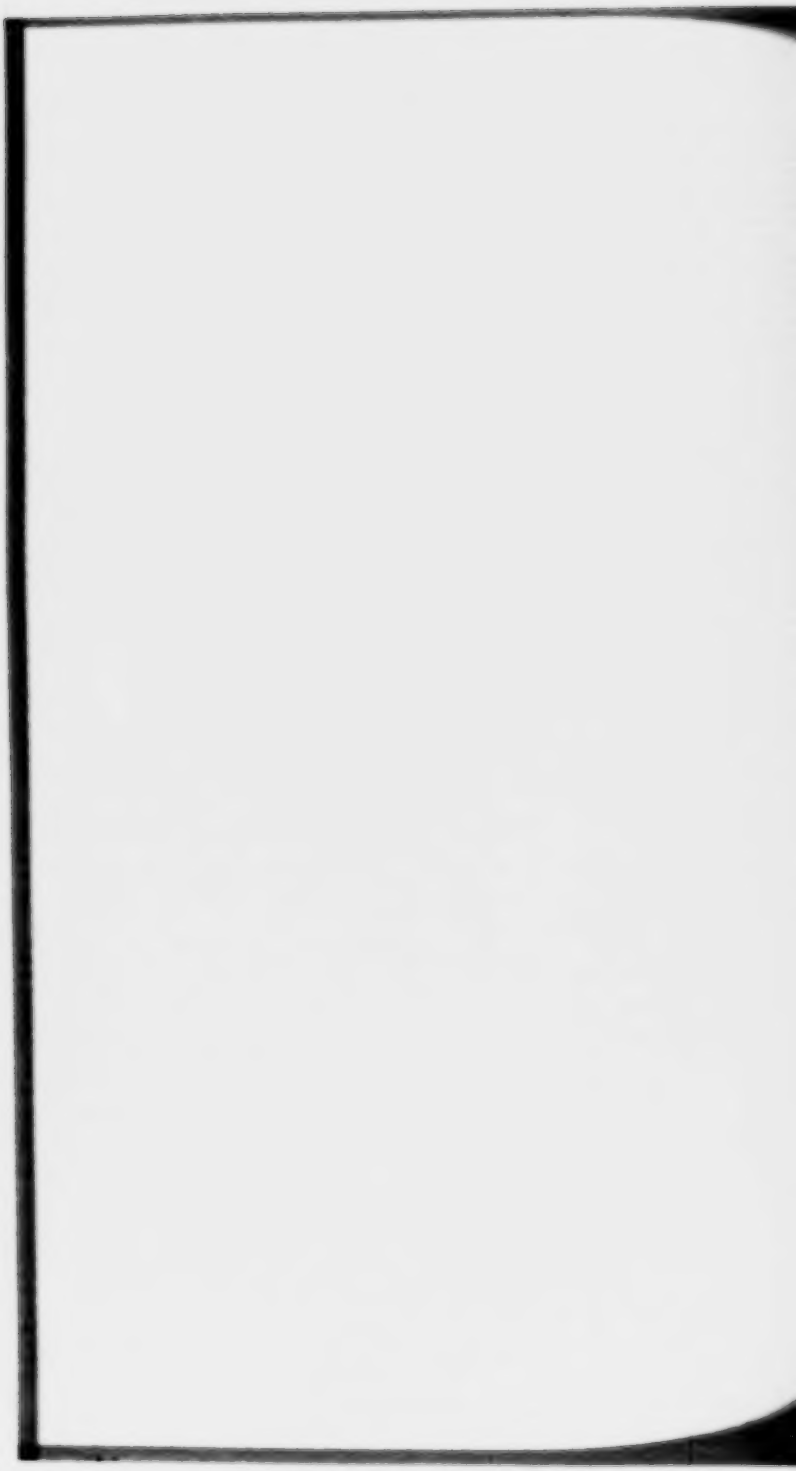

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portion of the mixing space, adjacent said shielded zone, being relatively small and being proportioned to cooperate with said variable low-rate burner to provide air for progressively increased combustion, in said zone and inner mixing-space portion, of gas-rich air-fuel mixtures supplied through said port means, the apertures at outer portions of said mixing space being larger and being proportioned to supply additional air for progressively higher rate combustion in said mixing space of gas-rich fuel supplied thereto through said port means and said low-rate zone, whereby said burner may be adjusted in operation from a high rate involving combustion at substantially all said air jets, through substantially continuous variations, down to a low rate o. combustion at said low-rate burner zone of said air jets.

5. A high turn-down ratio burner according to claim 7, in combination with supply means to supply controlled streams and proportions of air and fuel gas to said burner-body fuel passage for discharge from said port means, said supply means being constructed and arranged to supply low-rate streams of substantially combustible air-fuel mixtures for shielded combustion in said low-rate zone independently of air from the passing air stream, to supply progressively increased intermediate-rate deliveries of progressively gas-enriched air-fuel mixtures for progressive intermediate-rate combustion in said low-rate zone and with air from said small apertures, and to supply progressively higher rate deliveries of still higher gas-content fuel mixtures for progressive higher rate combustion with air from said larger apertures.

9. A high turn-down gas burner as defined in claim 7 in which said gas port means includes means to provide high-velocity gas jets and means to provide low-velocity gas supply at the base of said high velocity jets, said low velocity gas supply means serving at intermediate combustion rates to provide ignition flame for said high-velocity jets and at higher combustion rates to supplement the capacity of the gas port means to supply gas for combustion with said air jets.

10. Air stream heating apparatus, comprising a high turn-down ratio gas burner as set forth in claim 7 in combination with duct means forming a low-pressure air stream passage about said port said burner, and air propeller means for creating low-pressure air to flow forwardly in said passage at a velocity of the order of 1500 to 4000 feet per minute past said burner, the mixing plates of the burner being positioned to be impinged by said air stream and defining at their forward edges a cross-sectional outlet area at which said mixing space discharges in confluence with the passing air stream, said outlet area lying within the cross-sectional area of the air stream passage and being surrounded by an open air stream passage area of larger capacity than said apertures.

11. A high turn-down gas burner adapted for operation in an air stream flowing forwardly past the burner at a velocity of the order of 1500 to 4000 feet per minute, comprising an elongated burner body defining a gas fuel supply passage and having an elongated forward wall so located as to be transversely of the direction of the air stream, said wall having gas port means at a series of points along its length, flame shielding walls extending forward from adjacent the sides of the body in spaced relation along opposite sides of said gas port means, defining a low-flame zone in front of said gas port means, mixing plate walls extending obliquely forward and outward from said shielding walls in divergent relation at an included angle of the order of 30°, and walls defining a forwardly widening trough-shaped mixing space forwardly of said gas port means, said mixing space being forwardly wide open for free and open discharge communication with the passing air stream, said mixing plate walls projecting laterally of said burner body walls from which points positioned to be exposed to the air stream flowing past the burner, a plurality of apertures in said mixing plate walls spaced both longitudinally thereof and at different distances from said burner body, said apertures being smaller than the wall areas between the same and having a total area substantially less than the forward open discharge area of said mixing space, the inner apertures being of smaller capacity than the outer apertures, said burner body and divergent walls being shaped to divide and outwardly deflect the air stream flowing past the burner and cause such flow to create reduced pressure in said mixing space, and said apertures being positioned and arranged to admit and direct air from such passing air stream into the mixing space in distinct jets flowing obliquely forward and inward in said mixing space in front of said low-flame zone, said gas port means being operable to discharge variable amounts of gas fuel from said burner body to said low-flame zone and mixing space whereby to provide low flame combustion in said zone and progressively higher flame combustion involving progressively more of the spaced air jets in said mixing space.

12. A high turn-down ratio gas burner for operation in and for heating a low-pressure air stream flowing forward past the burner at a velocity of the order of 1500 to 4000 feet per minute, comprising in combination, an elongated burner body having means for connection to a supply of gas fuel and defining a feed passage and having a forward wall, means including gas port means connected to said passage for forming along said forward wall a variable low-rate burner for variable low-rate combustion of combustible gas fuel in a zone substantially shielded from the passing air stream and operable over a substantial turn-down range when supplied at varied rates with combustible gas fuel, shielding wall means connected to said burner body and extending forward in laterally spaced relation from opposite sides of said variable low-rate burner, said wall means defining in front of said variable low-rate burner a shielded zone in which said variable low-rate combustion can take place substantially independently of and shielded from the passing air stream and in which at higher combustion rates gas fuel can flow forwardly from said gas port means, mixing plates extending obliquely forward and outward from said shielding walls in widely divergent relation and defining at the front thereof a forwardly widening mixing space in open receptive communication with said shielded zone and having an open discharge at its forward end, said mixing plates being arranged for exposure to the air stream and for shielding said mixing space therefrom, means including a plurality of spaced rows of spaced apertures in said mixing plates for admitting jets of limited quantities of air from the passing air stream into said mixing space, said last-named means and the angular position of said mixing plates being arranged to cause said jets to stand in forwardly converging arrays of spaced jets, said apertures being of limited capacity and having a total area substantially less than the forward open discharge end of the mixing space between the plates, the apertures at the inner portion of the mixing space, adjacent said shielded zone, being relatively small and being proportioned to cooperate with said variable low-rate burner to provide air for progressively increased combustion, in said zone and inner mixing-space portion of gas fuel supplied through said port means, the apertures at outer portions of said mixing space being larger and being proportioned to supply additional air for progressively higher rate combustion in said mixing space of gas fuel supplied thereto through said port means and said low-rate zone, whereby said burner may be adjusted in operation from a high rate involving combustion at substantially all said air jets, through substantially continuous variations, down to a low rate of combustion at said low-rate burner inwardly of said air jets.

13. A high turn-down gas burner adapted for operation in an air stream flowing forwardly past the burner at a velocity of the order of 1500 to 4000 feet per minute, comprising an elongated burner body defining a gas fuel supply passage and having an elongated forward

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wall to lie transversely of the direction of the air stream, said wall having gas port means at a series of points along its length, flame shielding walls extending forward from adjacent the sides of the body in spaced relation along opposite sides of said gas port means, defining a low flame zone in front of said gas port means, mixing plate walls extending obliquely forward and outward from said shielding walls in divergent relation at an included angle of more than 30°, said walls defining a forwardly widening trough-shaped mixing space forwardly of said gas port means, said mixing space being forwardly wide open for free and open discharge communication with the passing air stream, said mixing plate walls projecting laterally of said burner body with their back faces positioned to lie exposed to the air stream flowing past the burner, a plurality of apertures in said mixing plate walls spaced both longitudinally thereof and at different distances from said burner body, said apertures being smaller than the wall areas between the same and having a total area substantially less than the forward open discharge area of said mixing space, the inner apertures being of smaller capacity than the outer apertures, said burner body and divergent walls being shaped to divide and outwardly deflect the air stream flowing past the burner and cause such flow to create reduced pressure in said mixing space, and said apertures being positioned and arranged to admit and direct air from such passing air stream into the mixing space in distinct jets flowing obliquely forward and inward in said mixing space in front of said low-flame zone, said gas port means being operable to discharge variable amounts of gas fuel from said burner body to said low-flame zone and mixing space whereby to provide low flame combustion in said zone and progressively higher flame combustion involving progressively more of the spaced air jets in said mixing space.

14. A high turn-down gas burner adapted for operation in an air stream flowing forwardly past the burner at a velocity of the order of 1500 to 4000 feet per minute, comprising an elongated burner body defining a gas fuel supply passage and having an elongated forward wall to lie transversely of the direction of the air stream, said wall having gas port means at a series of points along its length, flame shielding walls extending forward from adjacent the sides of the body in spaced relation along opposite sides of said gas port means, defining a low-flame zone in front of said gas port means, mixing plate walls extending obliquely forward and outward from said shielding walls in divergent relation at an included angle of more than 30°, said walls defining a forwardly widening trough-shaped mixing space forwardly of said gas port means, said mixing space being forwardly wide open for free and open discharge communication with the passing air stream, said mixing plate walls projecting laterally of said burner body to effectively shield the mixing space from the air impinging upon the back faces of said mixing plate walls, a plurality of apertures in said mixing plate walls spaced both longitudinally thereof and at different distances from said burner body, said apertures being smaller than the wall areas between the same and having a total area substantially less than the forward open discharge area of said mixing space, the inner apertures being of smaller capacity than the outer apertures, said burner body and divergent walls being shaped to divide and outwardly deflect the air stream flowing past the burner and cause such flow to create reduced pressure in said mixing space, and said apertures being positioned and arranged to admit and direct air from such passing air stream into the mixing space in distinct jets flowing obliquely forward and inward in said mixing space in front of said low-flame zone, said gas port means being operable to discharge variable amounts of gas fuel from said burner body to said low-flame zone and mixing space whereby to provide low flame combustion in said zone and progressively higher flame combustion involving progressively more of the spaced air jets in said mixing space.

15. A high turn-down ratio gas burner for operation in and for heating a low pressure air stream flowing forward past the burner at a velocity of the order of 1500 to 4000 feet per minute, comprising in combination, an elongated burner body having means for connection to a supply of gas fuel and having a forward wall lying transversely of the direction of the air stream, gas port means located along said forward wall, wall means extending forwardly from said forward wall along opposite sides of said port means; said forward wall, gas port means, and wall means providing a variable low-rate burner for variable low-rate combustion of combustible gas fuel in a zone substantially shielded from the passing air stream and in which at higher combustion rates gas fuel can flow forwardly from said gas port means, mixing plates extending obliquely forward and outward from said wall means in widely divergent relation at an included angle of not less than 30° and defining at the front thereof a forwardly widening mixing space in open receptive communication with said port means and having an open discharge at its forward end, said mixing plates being arranged to shield said mixing space from air contacting the back faces of said mixing plates, said mixing plates being constructed so that a reduced pressure is produced in the mixing space as a result of the passage of said air over said back faces and ends of the plates, means including a plurality of spaced rows of spaced apertures in said mixing plates for admitting jets of limited quantities of said air into said mixing space, said aperture-including means and the angular position of said mixing plates being arranged to cause said jets to stand in forwardly converging arrays of spaced jets, said apertures being of limited capacity and having a total area substantially less than the forward open discharge end of the mixing space between the plates, the apertures at the inner portion of the mixing space, adjacent said gas ports, being relatively small and being proportioned to cooperate with said variable low-rate burner to provide air for progressively increased combustion, in said inner mixing-space portion, of gas fuel supplied through said port means, the apertures at outer portions of said mixing space being larger and being proportioned to supply additional air for progressively higher rate combustion in said mixing space of gas fuel supplied thereto through said port means, whereby said burner may be adjusted in operation from a high rate involving combustion at substantially all said air jets, through substantially continuous variation, down to a low rate of combustion at said low-rate burner.

16. A gas burner system, comprising a high turndown gas burner and means for generating a low pressure air stream having a substantially constant velocity within the range of up to approximately 4000 feet per minute for flowing forwardly past the burner, said burner including an elongated burner body, gas port means at a series of points along the burner body, shielding walls extending forwardly from adjacent the sides of the body in spaced relation along opposite sides of said gas port means defining a low-flame zone in front of and immediately adjacent said gas port means and independent of said air stream, means including said gas port means for causing a combustible mixture to exist in said low-flame zone, mixing plate walls supported on said shielding walls and extending forward and outward therefrom in gradually divergent relation, said walls defining a forwardly widening trough-shaped mixing space forwardly of said gas port means, said mixing space being forwardly wide open for free and open discharge communication with the passing air stream, said mixing plate walls projecting laterally of said burner body with their back faces positioned to lie exposed to the air stream flowing past the burner, a plurality of apertures in said mixing plate walls spaced at different distances from said burner body, said burner

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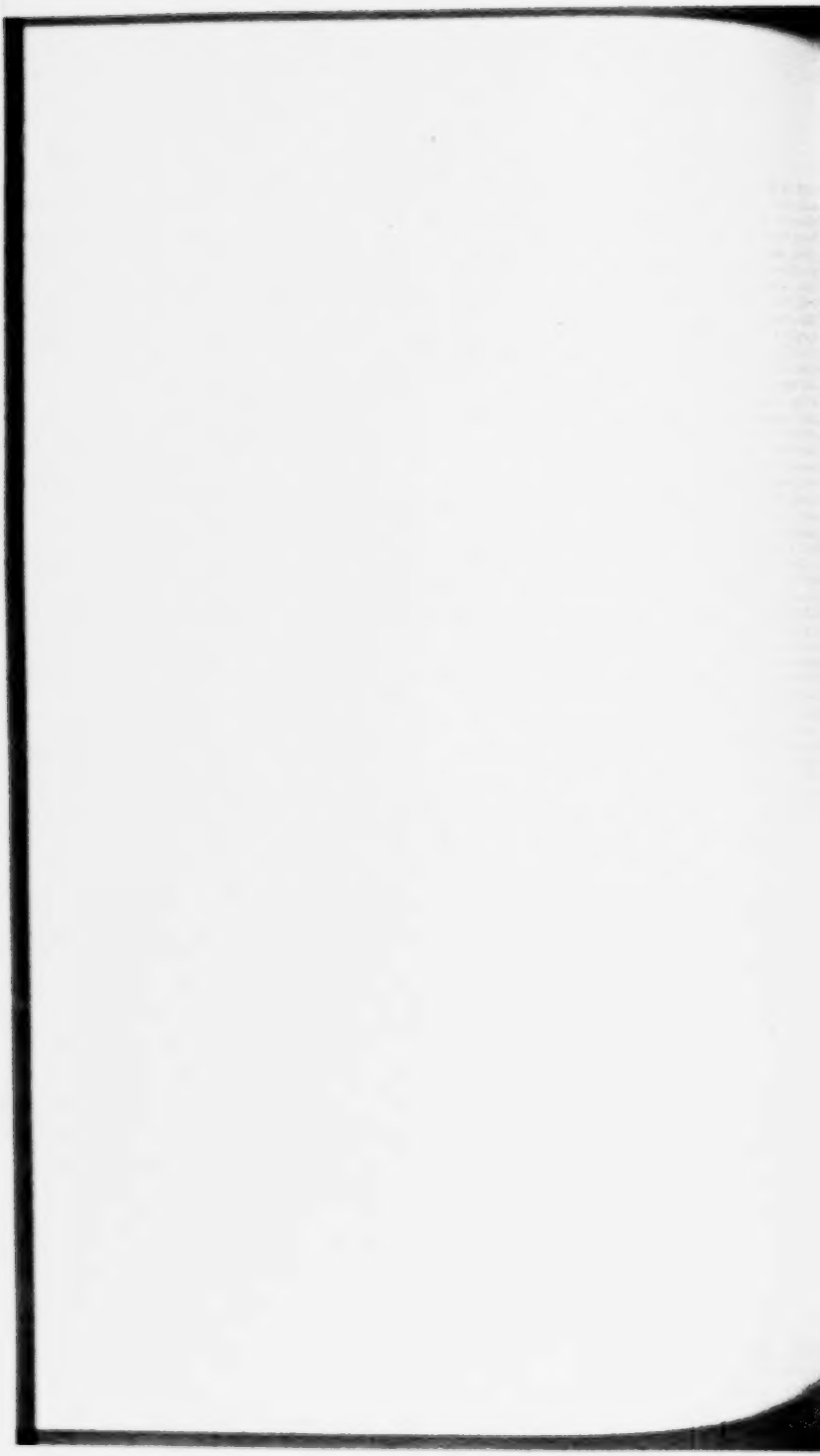

body and divergent walls being shaped to divide and outwardly deflect the air stream flowing past the burner to cause such flow to create reduced pressure in said mixing space, and said apertures being positioned and arranged to admit and direct air from such passing air stream into the mixing space in distinct jets flowing obliquely forward and inward in said mixing space in front of said low-flame zone, said gas port means being operable to discharge variable amounts of gas fuel from said burner body to said low-flame zone and mixing space.

17. A gas burner system, comprising a high turndown gas burner capable of operating at low, intermediate and high firing rates, and means for generating a substantially constant low pressure air stream having a substantially constant velocity of not more than approximately 4000 feet per minute for flowing forwardly past the burner, said burner including an elongated burner body, gas port means at a series of points along the burner body, shielding walls extending forwardly from adjacent the sides of the body in spaced relation along opposite sides of said gas port means and defining a low-flame zone in front of and immediately adjacent said gas port means, including said gas port means for causing a combustible mixture to exist in said low-flame zone, mixing plate walls supported from said shielding walls and extending forward and outward therefrom in divergent relation to define forwardly of said gas port means a forwardly widening trough-shaped mixing space that is forwardly wide open for free and open discharge communication with the passing air stream, said mixing plate walls projecting laterally of said burner body with their back faces positioned to lie exposed to the constant velocity air stream flowing past the burner, a plurality of apertures in said mixing plate walls spaced at different distances from said burner body, said apertures being positioned and arranged to admit and direct part of the air from such passing air stream into the mixing space in distinct jets flowing obliquely forward and inward in said mixing space in front of said low-flame zone, said jets being of substantially constant configuration irrespective of whether the burner is operating at low, intermediate, or high firing rate, said burner body and mixing plate walls being shaped to divide and outwardly deflect the air stream flowing past the burner such that the balance of the air stream not admitted through the apertures passes along said walls and past the burner to create a reduced pressure in said mixing space, said gas port means being operable to discharge variable amounts of gas fuel from said burner body to said low-flame zone and mixing space to cause at intermediate and high firing rates admixture and combustion of said gas fuel and said air jets thereby heating that part of the air that is within said mixing space, and finally to cause the air so heated to pass forwardly of the burner to reunite with and heat the balance of the air, without appreciably increasing the velocity or pressure of said balance of the air and therefore of the air stream flowing past the burner.

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ADDENDUM II

EXCERPTS FROM DISTRICT COURT'S FINDINGS OF FACT

[Because there was no District Court "opinion" as such, and this Court's Rule 21-1-i probably did not contemplate encumbering this petition with 116 pages of findings, even if reasoning is there included, the Clerk of the Supreme Court was consulted. At his suggestion, ten copies of the printed joint appendix used in the Court of Appeals have been furnished. Some findings, mainly those to which reference is made in this petition or in the Opinion of the Court of Appeals, comprise the present appendix. The entire Findings of Fact and Conclusions of Law are found in the white volume at pages 472 to 551 and also (without its record citations) at 171 USPQ 138-165. Finding 9 incorporates by reference a Stipulation of Uncontested Facts found in the white volume at pages 37-74.

[Each Finding included here is complete, and hence no deletions are indicated. The inclusion in this selection of findings relied upon by the Court of Appeals, if recognized by substance when the Court did not give a number, does not connote concurrence].

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6. Maxon's pre-trial papers submitted pursuant to this Court's Pre-Trial Order limited the infringement charge to Claims 3,7,8,10,12,16 and 17 of the Reissue patent in suit, of which the first four are original claims. By Order of this Court granting Maxon's motion to sever, the only issue of infringement here for decision is as to the four original claims, claims 3,7,8 and 10, the three reissue claims being held for later trial along with issues of intervening rights under 35 U.S.C. Sec. 252. Eclipse also presents for decision here the question of whether or not Maxon has been guilty of such inequitable conduct, unclean hands and laches as to bar it from maintaining this action. Both parties request costs, expenses, and attorneys' fees. Maxon also requests trebel damages for Eclipse's alleged knowing, deliberate, willful and wanton infringement, an accounting and a permanent injunction.

7. Only the infringement of claims 3,7,8 and 10 of the reissue patent are in issue, Eclipse having admitted the original patent 3,051,464 is valid, and therefore the claims in issue here are valid by virtue of the fact that they are identical to the same claims in the original patent. Maxon charges direct infringement, contributory infringement and inducing infringement
C1370 under 35 USC Sec. 271. While some of the claims of the reissue patent have already been held valid in this circuit in Maxon Premix Burner Co. v. Mid-Continent Metal Products Co., 279 Fed. Supp. 165 (D.Ill. 1967), they are not the claims involved here.

18. Eclipses's immediate discontinuance of the manufacture and sale of its infringing "AS" burners
C1377 after institution by Maxon of Civil Action 62-C-61 and the "confidential" and voluntary submission by Eclipse's patent counsel to Maxon's patent counsel of a print of Eclipse's Drawing 3TII-1754 and a print of the 1-22-63 Spielman sketch in order to disclose to

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Maxon what Eclipse *intended* to place on the market as a non-infringing substitute wide range line burner establishes a cognizable measure of good faith on the part of Eclipse.

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25. Further, with respect to the "confidential" submission of Eclipse's drawings, Maxon correctly points C1380 out that a confidential relationship cannot be established by a unilateral act of submission with a gratuitous statement of submission on such basis. It is also reasonably forseeable that Maxon's counsel would want to inform his client of the substance of the drawings, before giving patent clearance thereon, and indeed had the duty so to do or was without inherent authorization to do otherwise where the matter related to termination of pending litigation. Concomitantly, it is reasonably foreseeable that Eclipse might fairly assume that by Maxon's silence or failure to advise of filing of the reissue, it acquiesced in Eclipse's contentions of noninfringement by the new designs, and that Maxon would foresee that Eclipse would be spending funds in designing, engineering, advertising, and marketing of new burners. It is fundamental that attempting to "invent around" a patent is a beneficial consequence of the patent system; unfortunately for Eclipse it did not succeed but is not to be harshly penalized for the mere act of trying, in good faith to do so. While these and the facts in paragraph 24, negate Maxon's alleged unclean hands and bad faith, nevertheless on balance, affirmative refusal on the part of Maxon or its counsel to accept and review the drawings except on the understanding that they would be reviewed by Maxon's technical personnel would be a significant factor in establishing a proper basis for Maxon's request for attorneys' fees, depending, of course, on other relevant and attendant factors.

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27. Maxon accuses Eclipse of deliberate deception in misleading Maxon away from the exact construction of the "AH" burner. Maxon points out that the March 12 drawings do not represent the later actual "AH" construction. On July 20, 1965 Eclipse's patent counsel, sent to Maxon's patent counsel a print of Eclipse's Drawing 4TH-2560 (Exhibits D-11P and PX-28C) and an accompanying letter (Exhibits D-110 and PX-120) pointing out in detail the various reasons why Eclipse considered its "AH" types of burners would not infringe any of the ten claims of Maxon's original Patent No. 3,051,464. Maxon notes that Eclipse's Drawing 4TH-2560 is not an accurate illustration of Eclipse's commercial "AH" burner since it shows the apertures in the outwardly divergent, flame confining walls as being of uniform size instead of non-uniform size. This discrepancy is not of convincing legal significance because at the time Maxon had access to Eclipse's "AH" type burners in the hands of Maxon's customers, and had in its possession Eclipse's Bulletin H-100 (Ex. DDX-6C) published in April of 1964 and showing non-uniform holes.

30. Secondly, there is no basis for laches because of defendant's own conduct. Although defendant asserts that the relevant period for laches runs from the fall of 1963 until October 12, 1967 (Defendant's Pretrial Brief, page 94), the uncontradicted evidence establishes that plaintiff's management had no actual knowledge of the fully infringing construction of the accused assemblies until the period of February-May, 1966. On the contrary, Maxon was misdirected on two occasions as to the true construction of the accused burners. Specifically, in connection with the settlement of the previous lawsuit between the parties, defendant's counsel sent a sketch of a *proposed* burner construction, PX-26B and 26C with his letter of March 12, 1963 (PX-12H). Eclipse never manufactured a burner assembly having the

internal construction shown in PX-26B, and the in-
C1384 ternal construction cannot be ascertained from PX-
26C (R. 2157-72). Furthermore, at that time defendant had drawings of the AH assembly that it actually later made (R. 2878-82). On July 20, 1965, counsel for Eclipse sent Maxon's counsel a second drawing which purported to be the AH burner manufactured by Eclipse (PX-12-0, 2SC; R.2169). However, this drawing, like the earlier one, showed a burner having mixing plates with uniformly sized openings, contrary to the construction of the burner that was actually being manufactured by Eclipse at that time (R. 380-81, 1919, 2168-72). In January, 1966, on the advice of counsel, Maxon decided to actually purchase an AH burner (R. 389, 1920). This burner was examined and tested during February-May, 1966 (R.389). It was at this time that Maxon first realized that Eclipse was manufacturing and selling a burner having non-uniform apertures, and in their view had appropriated each and every feature of the Yeo invention (R.389, 1920). At this time, both plaintiff and its counsel were actively involved in pre-trial activities in Maxon v. Mid-Continent (R. 390). However, immediately after the termination of this case, Eclipse was given notice of infringement on October 12, 1967 (PX-12Q).

54. After some experimentation with various shielding techniques, Yeo and Waid realized that they were making a basic error in treating the air stream as a problem rather than as a helper. In January, 1957, they conceived the idea of a burner that harnessed the air stream and made it work for them instead of against them (R. 276, 884-85). The invention conceived by them was the combination of a low-fire burner structure, a shielding wall structure, and a mixing plate structure (R. 276, 885-86). Because of its appearance, the first model developed was referred to as a "Cabbage slicer". This burner was perfected and tested by June of 1957 (R. 886).

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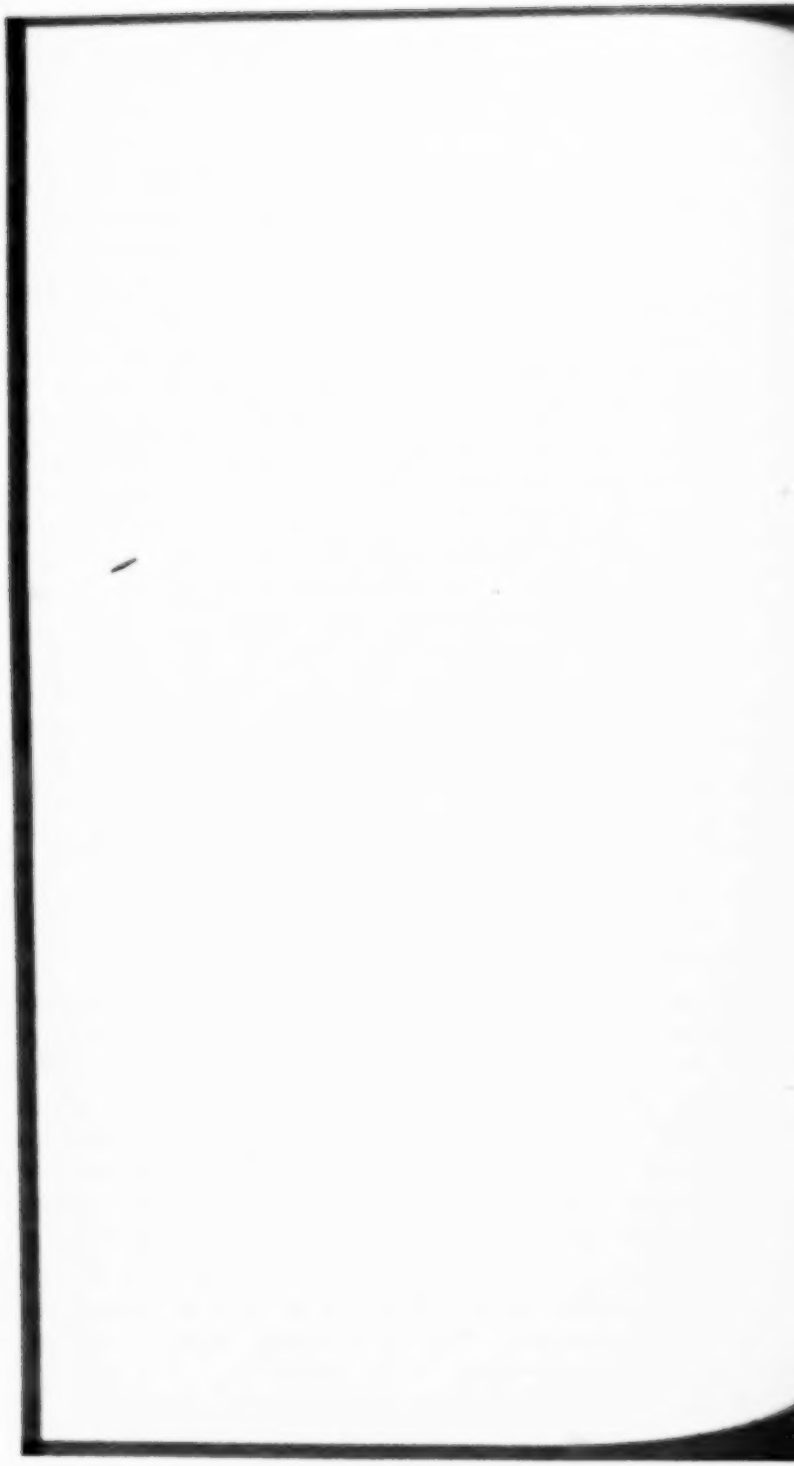

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68. As Mr. Yeo testified at trial, the AH burner proper, which is embodied in each of the AH burners and family of burners, has all of the elements of claim 3 of the patent in suit, which may be generally described as a low-rate burner structure, shielding wall means, and mixing plates. As set forth in more detail below, this combination of elements, as embodied in the accused burner assemblies, infringes claim 3 (R.1014).

72. In addition, the operating and performance characteristics of defendant's "burner proper," by itself or as embodied in the accused assemblies, are the same as the operating characteristics of plaintiff's Airflo burner, also embodying the Yeo invention. [5]

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[5] For example, the defendant's "burner proper," the accused assemblies, and plaintiff's Series 58 burner all have a turn-down ratio of at least 25 to 1, a high heat release per foot; a capability of operating in an air stream having a velocity of about 1500 to 4000 ft. per minute, a low-fire combustion occurring independently of air from the passing air stream, a mixing space shielded from the passing air stream by mixing plates, a standing array of forwardly converging jets of air; a gas path action on the mixing plates, a standing array of jets which provide vacuum pockets that produce gas paths for spreading gas onto the mixing plates, a smooth progression of combustion from low to a high fire; a progressive aeration for higher rates of combustion, uniform distribution of heat into the air stream; air-gas mixtures supplied throughout many firing rates within its normal operative range, a pressure drop across the mixing plates, an intense, nested, blue flame, interlaced fingers of flame clearly revealing a standing array of air jets, a low-fire flame having a narrow ribbon characteristic, an intermediate-fire characterized by fingers of flame at the inner rows of apertures, a high fire in which flame co-acts with all of the jets from all of the apertures, complete combustion at all firing rates, high-quality combustion at all firing rates, a flame front that moves forward-plates; production of carbon monoxide limited to 11 ppm or less; extremely low oxides of nitrogen (less than .5 ppm), no aldehyde odors, a comparable velocity of jet flow through apertures of the mixing plates, capability of operating in the same way in a small duct or a large duct, air from the air stream used for combustion at intermediate and high fire, and gas-rich fuel used at high fire (R.

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Plaintiff clearly demonstrated with tests and color
C1415 photographs that the operation of the AH burner proper in a moving air stream is unaffected by the piece-by-piece removal of the associated ducting and distributor plate (PX-40C 1-5 through 40 CCCCC 1-5; R. 1054-70, 1084-86). Coversely, plaintiff also demonstrated that a Maxon Series 62 burner, embodying the Yeo invention, operates equally well when surrounded by small ducting similar to that surrounding the AH burner and family of burners (PX-43A 1-4 & 44A 1-4; R. 1070-74, 1082-84). From these demonstrations, it can be concluded that it makes no difference to the performance of the burner if it is in a large duct where plaintiff's burners are ordinarily employed or in a small duct, such as that surrounding the
"burner proper" in the accused assemblies (R. 1974-
C1416 78; 1082-84, 1923-24). Thus, from every structural, functional, and performance standpoint, the Yeo invention, as defined by asserted claim 3, is found in defendant's "burner proper," by itself and as embodied in the entire family of accused assemblies. Accordingly, claim 3 is infringed.

84. From its analysis, Eclipse concludes that (1) the term "independently of" means that the low rate burner can take no air from the passing air stream and that (2) the term "independently of" distinguishes premix-type from raw gas low-fire burners.

85. The first conclusion is untenable, since it implies that there is some magic in the source of the air supply. Eclipse's own "expert" testified that the burner doesn't know and doesn't care where the air comes from (R. 3165).

Further, the patent in suit itself states that some air
C1423 can be taken from the air stream even when the low-fire burner is fed with air-gas mixtures (PX-1, Col. 10, lines 45-56, R. 3311).

86. As to the second conclusion, even if the phrase "independently of air from the passing air stream" limits the

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claimed low-fire burner to the use of air-gas mixtures (which it does not), defendant overlooks the fact that the low-fire burner of the accused assemblies uses air-gas mixtures supplied to the burner body (U.F. 73). While these mixtures may be outside the combustible range, imperfect practice of an invention does not avoid infringement.

87. The shielding wall element calls for "combustion" taking place "independently of and shielded from the passing air stream" (R. 973-74, 1849-50). In accordance with the meaning of the language itself, "independently of" can be construed to mean undisturbed and unharmed by the passing air stream (R. 973-74); "shielded from" is construed to mean that the combustion is protected and separated by the shielding walls from the passing air stream (R. 1850, 3518-21).

100. Although the language appears only in the preamble, and therefore is not a requisite element of the claim, the claims also state that the burner in accordance with the Yeo invention is a "high turn-down ratio gas burner," and is "for operation in and for heating a low-pressure air stream flowing forwardly past the burner at a velocity of the order of 1500 to 4000 ft. per minute". Eclipse admits that the AH burner and family of burners have a turn-down ratio of at least 30-1, which is a high turn-down ratio as defined by the patent in suit (U.F. 33, R. 983-84; PX-1, col. 2, lines 1-4, col. 4, lines 39-47). As to the velocity past the burner, it has consistently been
C1432 the practice in the art to measure this velocity at the downstream end of the mixing plates, which is ordinarily the point of maximum constriction in the duct (R. 986-87, 1427, 1848). Velocity at other points in the duct does not affect the burner performance, and is unimportant (R. 1427-29). In fact, the measurement of velocity past the burner is simply another way of mea-

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suring pressure drop across the burner (R. 1428-29). When profile plates are employed, these profile plates are aligned with the forward face of the burner, and the velocity is measured at this point, again the point of maximum construction (R. 240, 1034). Prior to the filing of the application for the Yeo et al patent, it was known and recommended to use such profile plates with burners, including burners embodying the Yeo burner invention, in order to achieve the proper velocity (R. 1260-62). It is noted that when the defendant measured velocity for its motion pictures and tests, this velocity was invariably measured at the profile opening which was at the forward face of the burner (R. 2666). It is uncontradicted that, in normal operation, the accused Eclipse burners have an air stream velocity in the range of 1500 to 4000 feet per minute past the burner at the perforated profile (U.F. 113-140, and Eclipse's own measurement shown that the velocity through the perforated profile would be about 2677 feet per C1433 minute (PX-27G; R. 699, 989-90). The fact that velocities of less than 1500 feet per minute are encountered behind the forward face of the accused burners (R. 859), is immaterial, as this is not the normal place to measure velocity. Such lower velocities are, in fact, also encountered during normal operation of the Maxon AIR-FLO burners (R. 1040).

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1. Defendant's Mixing Plates are "Arranged for Exposure to the Air Stream"

103. The expert witness of Eclipse testified that a file wrapper estoppel has been created which limits the claims to a burner in which the mixing plates are arranged for exposure to the air stream (R. 3208). The presence or absence of a file wrapper estoppel on this point is irrelevant, since the mixing plates of the accused burners are arranged

for exposure to the air stream as recited in the claims. Maxon urges no broader reading. It is, of course, Eclipse's contention that the "air stream" is not the air moving over the burner in the small duct (R. 3177-82). As previously discussed, this contention is contradicted by the evidence of record that there is an air stream in the small duct of the accused burners, and that this air stream passes over the backs of the mixing plates (U.F. 45(b)-(c), 85, 108-09; R. 337, 2746-50, 3182).

C1435 104. Eclipse's position rests upon its contention that the "AH" burner assembly does not "utilize the air stream itself . . . to provide the operating pressure conditions." However, the proper inquiry is whether the "burner proper" utilizes the air stream itself to provide the operating conditions—and it is undisputed that it does (R. 2746-47). As admitted by Eclipse's own witnesses, if the air stream in the small duct is shut off, the accused assemblies are each rendered inoperative (R. 2123-24, 2746-47).

C1438 3. The Claims do Not Exclude a Low-Rate Burner That Takes Air for Combustion from the Passing Air Stream

109. The expert of Eclipse contended at trial that the file history (PX-2A) creates an estoppel against reading the claims on a low-rate burner structure which takes air from the air stream (R. 3227). The file wrapper simply does not create such an estoppel. In support of its position, Eclipse refers to a summary of the claimed invention which appears at pages 182-84 of the file history (R. 3221-27). This summary simply states that the invention comprises three elements—a variable low-rate burner, shielding walls, and mixing plates. The applicant's attorney gave a paraphrased description of each of these elements. Regarding the low-rate burner, the applicant's attorney simply stated that it was "operable over a range, say 8 to 1,

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independently of air stream air, when supplied with combustible air-gas mixtures . . ." (PX-2A, p. 182).

110. The foregoing language is a paraphrase of the claim language. In addition, it is important to bear in mind that the summary of the invention at pp. 182-84 of the file history was made in the context of the claims being "distinguished from the jet engine patents" (R. 3221-32). Significantly, the Way patent has no low-rate burner structure separate and distinct from its perforated flame basket. In the Way patent, all of the low fire combustion takes place in the air stream itself which, in essence, flows through the flame basket (R. 3518-21). The asserted C1439 claims merely require that the low-rate combustion be independent of air from the passing air stream. This is true in both the accused assemblies and in the Yeo invention, but is not true in the jet engines (R. 3518-21). Moreover, even accepting Eclipse's premise that the paraphrased language is controlling this language nonetheless covers a raw gas, a partial premix, or a full premix low-rate burner structure whose low-rate combustion is independent of (unharmed by or unaffected by) the air from the passing air stream (R. 973-74, 1849-50). Parenthetically, defendant Eclipse concedes that low-fire combustion in its low-rate burner is "shielded from" the air stream in the small duct (Defendant's Brief, p. 365; R. 3424).

VIII. DEFENDANT IS NOT FOLLOWING THE PRIOR ART

129. As part of its non-infringement defense, Eclipse asserts that it was "following the prior art", and not the teachings of the Yeo et al patent. In support of this contention, Eclipse relies upon (1) patents relating to jet engines, (2) prior art burner patents, and (3) a device known as the Western Products Heater. This defense is not convincing.

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The prior art relied upon by Eclipse does not teach the accused burner assemblies, and does not restrict the asserted claims of the patent in suit from covering the C1449 accused assemblies. On the contrary, the "burner proper" of Eclipse is covered by the asserted claims, and is unlike the teachings of the prior art.

A. The Jet Engine Patents Do Not Restrict the Claimed Yeo et al Invention

130. The function of a jet engine is to produce thrust, and heat is an unwanted by-product producing design complications (R.3462, 3505-06). In contrast, the purpose of the burners involved in this lawsuit is to generate heat (R.3462, 3506). A jet engine has a turbine at the rear of the combustion section which drives a compressor at the forward end of the combustion section to build up a large mass of high-pressure air (R.3059-60). None of this related equipment is found in wide-range line burners of the type involved in this litigation (R. 3491, 3506-07). The velocities involved in jet engines are extremely high, and this also contrasts with the burners involved in this lawsuit, wherein the velocities are much lower (R.3507-09). Specifically, velocities in jet engines range anywhere from 6,000 to 18,000 feet per minute, whereas plaintiff's Airflo line burners are designed to operate in air moving at a velocity of about 1500-4000 feet per minute (R. 3442-43; 3507-08). The large volume passing through the small structure in a jet engine requires pressures from about 4 to 150 pounds per square inch. In contrast, the wide range line burners in suit operate at pressure of around C1450 ½ pound per square inch (R.3508). The speed of the air stream in jet engines is variable, while the speed of the air stream in most air-in-motion applications remains constant (R.3441, 3507). Inlet air temperatures in a jet engine range from about 300 to 700 or 750° F., while Maxon's Airflo burner in a make-up air application

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would operate at inlet air temperatures which depend upon the climate, and would vary from around 60 or 65° down to minus 20° F. (R.3509). In oven-heating applications, the air approaching the burner is frequently of the order of 300 to 350° F. (R.3509). Downstream temperatures in a jet engine range from 1000 to about 1800° F., while plaintiff's burner produces downstream temperatures in a range of 14 to 80° F. in make-up air applications, and as high as 1000° F. in some special drying applications (R. 3509-10). The jet engine combustion devices utilize liquid fuel, as contrasted with the gas fuel used in the wide-range gas burners involved in this litigation (R.3444, 3511). Jet engines burn with a yellow flame, and produce significant quantities of pollution, so that they would be unsuitable for make-up air, process fresh air, or even recirculating applications (R. 3455-56, 3513). Maxon's expert witness, Mr. Robert H. Yeo, testified that the jet engine patents are not the kind of art to which one skilled in the line burner art would turn to design a wide-range line burner (R. 3514, 3533). Finally, jet engine combustion devices were specifically found to be non-analogous art by another Judge of this Court in his decision in Maxon Premix Burner Company, Inc. v. Mid-Continent Metal Prods. Co., 279 F. Supp. 164 N.D. Ill. (1967). For all of these reasons, the jet engine combustion devices have different performance characteristics, operating principles, and environmental conditions than those of the Yeo burner invention.

C1451

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DECISION ON POST-TRIAL MOTIONS
(Filed August 23, 1971)

Marovitz, U. S. District Judge

Subsequent to trial, and decision in this case dated July 2, 1971, the parties have filed a series of five interrelated motions. The motions are directed to aspects of the findings of fact and conclusions of law, and to procedures relating to prospective appeals and future trial of issues relating to claims in the reissue patent in suit No. Re. 25,626 which were not in the original patent No. 3,051,464.

The parties have presented the court with briefs and memoranda on the various points raised by the motions, and they have had an opportunity to present their views in oral argument before the court on August 9,
C1009 1971. The court having been fully advised in the premises, rules as follows on the Motions.

PLAINTIFF'S PROPOSED WRIT OF PERMANENT INJUNCTION

Pursuant to this court's July 2 decision, the plaintiff has proposed a writ of permanent injunction which was submitted to defendant's counsel for approval as to form. Because of defendant's position on the motions discussed below, defendant's counsel has refused to give its approval.

Upon review, the proposed writ of permanent injunction as proposed by plaintiff will not be entered because its scope exceeds paragraph 8 of the Judgment Order entered with the Memorandum of Decision dated July 2, 1971. The proposed writ must also be modified pur-

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suant to this court's ruling below on defendant's motion with respect to Finding of Fact 127.

Attached hereto is the court's own writ of permanent injunction which shall be entered within ten days from this date.

DEFENDANT'S MOTION FOR PROMPT TRIAL OF SEVERE ISSUES

Defendant has moved that this court set a prompt trial date for trial of the issues which were severed early in this case, those relating to the validity and infringement of Claims 12, 16, and 17 of patent C1010 Re. 25,626. These claims were broadened by the reissue procedure and were not present in the original patent No. 3,051,464.

Defendant's Motion is denied. Plaintiff, in oral argument before this court on August 9, 1971 has indicated that the issues with respect to these claims may be rendered moot in the event that this court's decision on the original claims 3, 7, 8 and 10 is affirmed by the Court of Appeals, should there be an appeal by defendant. Apparently, the reasoning is that if the accused devices infringe the original claims 3, 7, 8 and 10, there is no need to have another trial to determine that the devices also infringe the claims broadened in the reissue procedure.

This motion more suitably lies in the mouth of plaintiff who has brought the original complaint. Indeed, it may be questionable to go forward on questions of intervening rights with respect to Claims 12, 16 and 17 in view of the fact that Stipulation Of Uncontested Facts No. 101 states:

> "If any one or more of asserted Claims 1 through 10 of the reissue patent in suits is adjudged in-

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fringed, defendant has acquired no alleged intervening rights after the grant of the original patent No. 3,051,464."

Further, defendant has brought still another motion (see below) in which it seeks to contest the validity of the original Claims 3, 7, 8 and 10. If the Court of Appeals should rule that plaintiff has this right, then it would be advisable to include that issue in any subsequent trial. If this motion of defendant was to be granted, there could be three trials. This delay of any trial on the remaining claims of the reissue patent to see if the question of validity is to be added is a better conservation of judicial energy than immediately proceeding with issues that may become moot.

C1011

While the general principle of avoiding piece-meal litigation is appropriate in patent cases, it is felt that in view of the situation presented, it is within the bounds of the court's discretion to deny the motion for immediate trial of severed issues. This is particularly the case where defendant in an earlier consent judgment between the parties as to the original patent No. 3,051,464 consented that original Claims 1 through 10 were valid, and did not raise issues of validity during trial. The issues at trial were confined to those of non-infringement, laches and unclean hands. Paper Converting Machine Co., Inc. v. FMC Corp., 409 F. 2d 344, 161 USPQ (7th Cir. 1969), Cert. Denied 396 U.S. 877.

DEFENDANT'S MOTION FOR LEAVE TO CONTEST VALIDITY OF ORIGINAL CLAIMS 3, 7, 8 and 10

Defendant also moves for leave to contest validity of original Claims 3, 7, 8 and 10. As noted above, defendant did not contest validity of these claims during the original trial, restricting its attack on the patent to the scope

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of the claims as relating to its non-infringement defense.

C1012 Defendant's position is that in view of the recent Supreme Court case of Lear, Inc. v. Adkins, 395 U. S. 653, 162 USPQ 1 (1969) there is a strong public policy which would permit the defendant to challenge the validity of the patent in spite of the fact that it has entered into a consent judgment of validity as to these same claims in a prior suit between the same parties.

While the results of licensee estoppel and a consent judgment is effectively the same, in the sense that both the licensee and the consent judgment defendant are prohibited from challenging the validity of the patent, this court is not convinced that the public policy applying to a patent licensee, permitting the challenge of validity, extends to consent judgments. The Lear case permits challenge by a licensee who has privately agreed with the patentee not to challenge the validity, to do precisely that in spite of the language of the contract. However, we have here the intervention of a court by entry of a judgment, although it be by consent and without trial on the merits. It is the policy of the courts to encourage settlement. Defendant's motion in effect pits the public policy articulated in the Lear case against the policy of encouragement of settlement.

However, this court, being cognizant of the strong public interest in permitting full and free competition in the use of ideas which are in reality a part of the public domain, is of the opinion that its present Order C1013 denying defendant's motion involves a controlling question of law as to which there are substantial grounds for differences of opinion, and that an immediate appeal upon the order may materially advance the ultimate termination of the litigation. Therefore, should

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defendant proceed with an appeal in this case, this court certifies this issue within the meaning of 28 USC Sec. 1292(b).

DEFENDANT'S MOTION FOR SETTING EQUITABLE TERMS FOR CONTINUATION BY DEFENDANT OF MANUFACTURING ACTIVITY

Defendant moves that any injunction issuing in this case be modified by a provision for setting of terms upon which defendant will be permitted to continue its present manufacture. Defendant urges that its manufacture was begun in good faith reliance on claim language which it, upon advice of counsel, felt limited the claims in a manner which exclude its accused devices. Defendant directs the court's attention to 35 USC Sec. 252 which empowers the court in equity to set terms for continued manufacture where claims have been broadened by reissue. Defendant urges that here, where the court has allegedly "broadened" claims of the reissue patent which were in the original patent, an analogous equity applies.

This motion is denied. There is no statutory support for such a broadening of the powers of this court, and defendant cites no case law in support of its position.

C1014 DEFENDANT'S MOTIONS UNDER RULE 52 (b) AND 59(e) FOR AMENDMENT OF FINDINGS OF FACT, CONCLUSIONS OF LAW AND THE JUDGMENT ORDER

Defendant has brought a pair of interrelated Motions basically concerning its Finding of Fact 127 in this court's Memorandum of Decision dated July 2, 1971, Conclusions of Law No. 3 and paragraph 8 of the Judgment Order. Basically, these all concern amending the finding

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of fact to make provision for a ruling of non-infringement as to one type of defendant's AII burner assembly in which the holes in the mixing plate walls are of uniform size. Defendant's Motion is granted.

Defendant points out in its Motion that the last sentence in the Findings of Fact 127 is inaccurate. This Finding discussed a prototype burner made in September 1963. The sentence in question stated: "This prototype burner made in 1963 had such uniformly sized apertures, but were never sold commercially (U. F. 205; PX-28C; R. 207980)."

Based on a review of the record as a whole, it appears that there is substantial credible evidence to indicate that one AII burner having uniformly sized apertures in the mixing plates was sold to the DeVilbiss Company in Toledo, Ohio in September of 1963.

The testimony of Messrs. Spielman and Wilcox adequately ties together defendant's Exhibit No. 32A, an invoice showing a sale of an AII burner on October 16, 1963, with the defendant's exhibit showing the apertures of the mixing walls of defendant's AII burner of that time were uniform (see defendant's Exhibits 34E, plaintiff's Exhibits 20A-C, defendant's Exhibit 11P, and drawing No. 4PH-2560). Seeming inconsistencies in the testimony of defendant's witnesses with respect to this matter are at best slight, and not convincing of lack of credibility on this issue. The court is convinced that a burner having such apertures was constructed, tested at the DeVilbiss Company, and sold to that company in the Fall of 1963. It is clear from the record that only thereafter, on November 4, 1963, that the mixing plate apertures were changed to a non-uniform configuration.

C1015

Contrary to plaintiff's assertions, the question is not one of commercial sale within the meaning of 35 USC 102(b) as compared to an offer for sale. It is likewise

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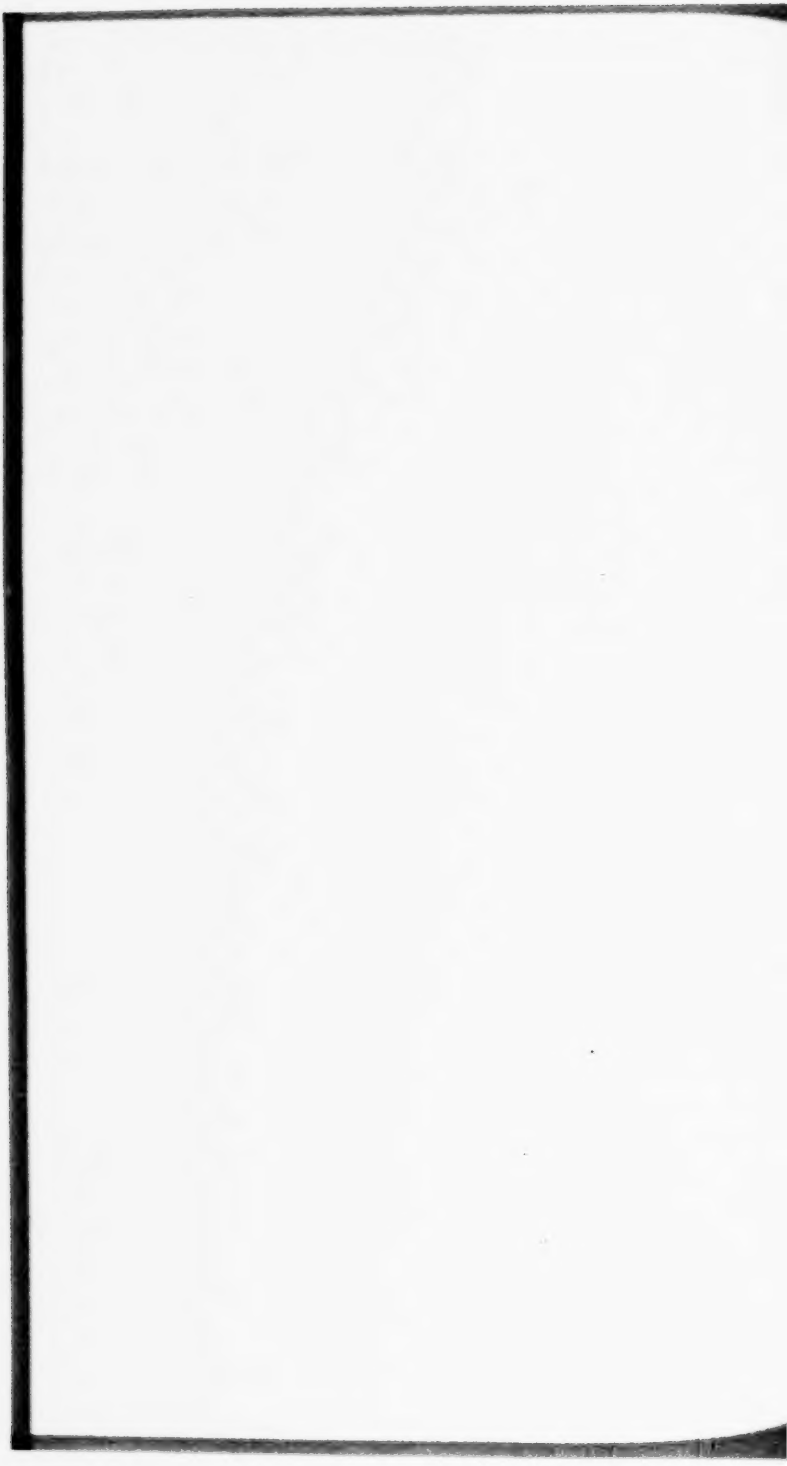

not a question of whether the burner was constructed by hand as compared to full commercial production. Nor is the matter a question of single sale being de minimis in the sense of contest of venue.

The record as a whole supports the conclusion that such type of burner, coming under the AII designation, was actually made by defendant, offered for sale at a trade show, and one was tested and sold to the DeVilbiss Company. This is adequate to establish that the issue here is real, and that this court in considering the question of uniformity versus non-uniformity of apertures is not giving an advisory opinion on a hypothetical structure.

C1016 Plaintiff argues that a type of AII burner having uniform apertures in the mixing walls was not in issue in this case, was not charged with infringement, and was not adequately briefed or considered by the court. However, the Complaint in this case puts in issue all AII burners from the date of issuance of the patent in suit in 1962 to the filing of the action in 1968. This necessarily includes the AII type burners in 1963 which have uniform apertures in the mixing plate walls.

Further, Stipulation of Uncontested Fact 32 states:

> "Defendant's AII burner and family of burners are the accused burners in this action and include defendant's AII burner, RAII burner, AIIO burner, TAII burner, TAII-R burner, DAII burner, AH-D unit, RAII-D unit, AH-DS system, and AH-DP system."

Uncontested Fact 136 states:

> "The physical model of defendant's AII burner, displayed at the A.S.M. Show in Cleveland, Ohio in October, 1963 had uniformly sized apertures in its mixing plate walls."

Uncontested Facts 205 and 206 also tend to the same conclusion:

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"205. Defendant's AII burner as initially made commercially in 1963 had a burner body and diverging plate wall structure with uniformly sized apertures.
"206. On or about November 4, 1963, defendant discontinued the use of uniformly sized apertures in its diverging plate wall structure and adopted non-uniformly sized apertures in its diverging plate wall structure in its AII burner."

C1017 From a review of the interrogatories and requests for admission it is evident that plaintiff had every opportunity to inquire into the structure of the pre-November 4, 1963 AII burner structure, and in fact exercised that opportunity.

It is clear from a review of the trial testimony and argument in connection with the position of the parties in this case, that plaintiff has conceded that the claims in issue, Claims 3, 7, 8 and 10 of the reissue patent, do not cover AII type burners having uniform apertures in the flame-confining walls. This was conceded by plaintiff's expert witness and vice president, Robert H. Yeo, who stated that where the walls had uniform apertures, "infringement of that claim [Claim 3] would not occur" (R. 1152-53). This testimony was the same as to Claim 7 (R. 1158). Since Claims 8 and 10 are dependent from Claim 7, they are likewise not infringed. This was confirmed by testimony of Mr. Yeo (R. 1159). Mr. Yeo is one of the co-inventors.

Representations of counsel for plaintiff during the trial confirms the concession by plaintiff that the claims in issue do not cover non-uniform apertures in the mixing plate. Indeed, considerable argument on the issues of laches and unclean hands concerned the change from uniform to non-uniform apertures. Plaintiff cannot seek to excuse its laches by arguing that it did not know that there had been a change from the non-infring-

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ing uniform apertures to the infringing non-uni-
C101S form apertures, and then urge that the uniform apertures should not be excluded from the coverage of the claims.

Plaintiff argues that defendant's experts have stated that there is no substantial difference between a burner having uniform and non-uniform apertures in the mixing walls. Based on this, plaintiff urges that it should not be denied the opportunity to show that uniform apertures fall within the scope of the claims based on the doctrine of equivalents. However, the statements of defendant's experts on which plaintiff relies, when taken in the full context of the line of questioning at the trial, do not support plaintiff's argument. The claims involved are directed to burner structure, and not to method of operation. Even where burners having uniform apertures found to have a performance equivalent to burners having non-uniform mixing plate apertures, it does not follow that the burners are legally equivalent. There may be many different structures which achieve the same end result, but which are not equivalent.

It must be recalled that the claims in issue specifically call for non-uniformity of apertures. Independent Claims 3 and 7 state, in pertinent part:

"***the apertures at the inner portion of the mixing space***being relatively small***, the apertures at outer portions of said mixing space being larger***." (PX-1, R. 375, 1152-55, 1158-61).

C1019 In view of the trial testimony of Yeo and related concessions of counsel, it is not germane to the present issue that the "non-uniform" limitation might not be a material limitation, and could possibly be ignored. This is not an interference. The limitation is in the claims, and is concededly material in the sense that if that element is omitted, there is no infringement.

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Therefore, defendant's motion shall be granted by deleting the last sentence of original Finding of Fact 127 and substituting the following therefore:

"****The prototype AII burner was made in the Fall of 1963 and had in the mixing plates thereof, apertures of uniform sizes as shown in PX-28B. It was, except for the uniform apertures, identical to other types of accused AII burners as otherwise exemplified by PX-28C and Exhibits 11P and 34E, and as established in the trial record (R. 702-3, 275-6). The 1963 prototype AII type burner was tested by The DeVilbiss Company of Toledo, Ohio in September of 1963. Such burner was both accepted and purchased by that company, the purchase being established by Eclipse's invoice of October 16, 1963, No.594060 (R. 2169-70, 2217-22, 2289-90, and 2455-59; Ex, 32A). That prototype AII burner, having uniformly-sized apertures in the mixing plates as illustrated in Exhibits PX-28B and Ex. 34E does not come within the scope of, or infringe Claims 3, 7, 8 and 10 of the reissue patent in suit, as conceded by plaintiff, by reason of the fact that such claims are each expressly limited or restricted to burners having mixing plates with non-uniformly-sized apertures therein. Independent Claims 3 and 7, from which Claims 8 and 10 depend, expressly state:

C1020 '**** the apertures at the inner portion of the mixing space *** being relatively small ***, the apertures at outer portions of said mixing space being larger ***.' (PX-1, R. 375, 1152-55, 1158-61)."

This revision is entirely consistent with the original Finding 128 in which it was found "that with the adoption of non-uniform apertures, Eclipse came within the scope of the patented invention."

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In accord with this revision of Finding 127, Conclusion of Law 3 should be clarified to read:

"3. United States Letters Patent No. Re. 25,626, as to Claims 3, 7, 8 and 10 is infringed by defendant, by its manufacture and sale of its accused burner assemblies which include mixing plates having small inner apertures and larger outer apertures therein. Defendant's manufacture and sale of its prototype AII burner assembly in October, 1963, having mixing plates with uniformly-sized apertures therein did not infringe any claims 3, 7, 8 and 10 of the United States Letters Patent No. R. 25,626."

DEFENDANT'S REQUESTED CLARIFICATION OF THE JUDGMENT ORDER

Finally, defendant requests clarification of the judgment order to more specifically identify the claims in issue. Although this matter would appear to be self-evident, the court is in accord with such type of clarification and accordingly, the judgment order paragraphs 4 and 5 will be revised to read as follows:

"4. Judgment on the complaint is entered for the plaintiff as to Claims 3, 7, 8 and 10.

C1021 "5. Defendant's Counterclaim is dismissed with prejudice as to Claims 3, 7, 8 and 10.

So Ordered."

/s/ Abraham L. Marovitz
Abraham L. Marovitz,
U. S. District Judge

Date: August 23, 1971.

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In The United States District Court

• • (Caption—Civil Action No. 68-C-132) • •

WRIT OF PERMANENT INJUNCTION

Defendant, Eclipse Fuel Engineering Co., (hereinafter "Eclipse"), its officers, agents, employees, servants and attorneys, and all persons in active concert or participation with them who receive actual notice of this Writ, are hereby enjoined from directly or indirectly making or selling, causing to be made, or sold, or offering to make, or sell from this day forward any AII burner assembly or family of burner assemblies which include in the mixing plates thereof smaller inner apertures and larger outer apertures, such as are included in type AII burner assemblies, type RAII burner assemblies, type AIIO burner assemblies, type TAII burner assemblies, type TAII-R burner assemblies, type DAII burner assemblies, type AII-D units, type RAII-D units, type AII-DS systems, and type AII-DP systems, and any burner assembly unit and/or system which embodies the inventions of any of the Claims 3, 7, 8 and 10 of the United States Letters Patent No. Re. 25, 626, and from contributing to the infringement of, or inducing the infringement of any of said claims from this day forward as to such burners.

/s/ Abraham L. Marovitz
United States District Judge

Dated: August 23, 1971.

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ADDENDUM IV

TEXT OF OPINION OF THE UNITED STATES COURT OF APPEALS FOR THE SEVENTH CIRCUIT IN THIS ACTION

(with added marginal cross-references to related parts of the foregoing petition).

Nos. 71-1756 and 71-1757

MAXON PREMIX BURNER COMPANY, INC.,
Plaintiff-Appellee,

vs.

ECLIPSE FUEL ENGINEERING CO.,
Defendant-Appellant.

Appeal from the United States District Court for the Northern District of Illinois, Eastern Division.
Case No. 68 C 132
ABRAHAM L. MAROVITZ,
Judge.

ARGUED JUNE 9, 1972 — DECIDED SEPTEMBER 18, 1972.

Before SPRECHER, *Circuit Judge*, DURFEE, *Senior Judge*,* and ESCHBACH, *District Judge*.**

SPRECHER, *Circuit Judge*. Eclipse Fuel Engineering Company appeals from a district court decision enjoining Eclipse from infringement of a patent owned by Maxon Premix Burner Company, Inc. Maxon cross-appeals, challenging a finding of non-infringement by a prototype burner developed by Eclipse in 1963.

Maxon and Eclipse are engaged in the business of selling industrial gas burners. For many years the parties

Pet. p. 6 (7)

*Senior Judge James R. Durfee of the Court of Claims is sitting by designation.

**District Judge Jesse E. Eschbach of the Northern District of Indiana is sitting by designation.

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to this appeal competed in production and sales of line burners used for heating moving air by direct contact with a gas flame. Operation of these burners revealed that improvement was needed in several respects. The operative range of a single burner was so limited that multiple burners were necessary to increase the maximum firing rate and the "turn-down" ratio of the burner arrangement.[1] The installation of multiple burners required duplicate auxiliary equipment and a complicated control system. The firing ratio in a multiple burner system was not smooth and continuous and heat distribution was not of a uniform pattern.

In 1955, Maxon began a development engineering project which culminated in a line burner which operated without the disadvantages described above. The new burner was patented and immediately enjoyed commercial success. This suit resulted from attempts by Eclipse to copy Maxon's successful innovation. p.8-10

Maxon's improved burner was patented in 1962 under U.S. Patent No. 3,051,464. In 1964, reissue Patent No. Re 25,626, the subject patent in suit, was granted. The reissue patent included additional claims but the claims held infringed were all included in the original patent. The district court held claims 3, 7, 8 and 10 infringed by Eclipse's AH, RAH, AHO, TAH, TAH-R and DAH burner assemblies, AH-D and RAH-D units, and AH-DS and AH-DP systems.

The parties agree that claim 3 is representative of the patent claims held infringed. Claim 3 is for a "high turn-down ratio gas burner for operation in and for heating a low-pressure air stream flowing forward past the burner at a velocity of the order of 1500 to 4000 feet per minute" and comprising in combination: p.10,11

(1) "a variable low-rate burner for variable low-rate combustion of combustible air-gas mixtures indepen-

[1] Turn-down ratio refers to the ratio of maximum heat input to minimum heat input available from the burner system. In one area in which the type of burners involved in this suit are used, that of "make-up air heating," where air exhausted from a room or compartment is replaced by outside air, it is desirable to maintain the temperature of the compartment air at a certain level at all times. A high turn-down ratio is required to accommodate a closely controlled inside air temperature to the variable outside air temperature conditions.

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dently of air from the passing air stream and operable over a substantial turn-down range when supplied at various rates with combustible air-gas mixtures;" p.12 7

(2) a "shielding wall . . . connected to said burner body and extending forward in laterally spaced relation from opposite sides of said variable low-rate burner, said wall means defining in front of said variable low-rate burner a shielded zone in which said variable low-rate combustion can take place independently of and shielded from the passing air stream and in which at higher combustion rates fuel gas can flow forwardly from said gas port means;" p.12

(3) "mixing plates extending obliquely forward and outward from said shielding walls in widely divergent relation and defining at the front thereof a forwardly widening mixing space in open receptive communication with said shielded zone and having an open discharge at its forward end, said mixing plates being arranged for exposure to the air stream and for shielding said mixing space therefrom, . . ."[2] n.8

Eclipse urges several grounds for reversal of the district court judgment. It argues that the court erred in refusing to make a finding on patent validity, in finding infringement of the patent in question, and in refusing to hold that Maxon was estopped from bringing this suit on the basis of long term knowledge of and acquiescence in defendant's actions. We are unable to agree with these contentions. p.14 p.15,16

I.

Eclipse insists that the district court judgment cannot stand because the decision did not include an affirmative

[2] Claim 7 differs from claim 3 in requiring the presence of "flame retention means" in the low-rate burner. Claims 8 and 10 are dependent on claim 7, claim 8 adding supply means to supply controlled amounts and proportions of air and fuel gas to the burner, and claim 10 adding duct means to form a low-pressure air stream passage about the burner and air-propelling means to induce low pressure air to flow forwardly in the passage.

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finding of patent validity.[3] Maxon argues that Eclipse waived its right to contest validity through a prior consent judgment between the two parties and through its concession during trial that validity was not in issue. p.15-17

The earlier consent judgment followed suit by Maxon in 1962 charging infringement of the original patent by a prior Eclipse burner. This litigation concluded with a settlement agreement in which Eclipse acknowledged validity of U.S. Patent No. 3,051,464 and agreed not to manufacture or sell any burner covered by the patent claims. Following this agreement, Eclipse discontinued production of the burner involved in that litigation and introduced the burner now held to infringe reissue patent No. Re 25,626. As noted above, the claims held to be infringed by the reissue patent are identical to those in the original patent. p.8

Eclipse argues that the prior consent judgment does not preclude it from challenging validity in this action under *Lear, Inc.* v. *Adkins*, 395 U.S. 653 (1969) and *Business Forms Finishing Service, Inc.* v. *Carson*, 452 F.2d 70 (7th Cir. 1971). *Lear* held that a licensee was not estopped from challenging the validity of a patent notwithstanding the licensing agreement. *Business Forms* held that the rationale of *Lear* required that a party be permitted to challenge validity even though a prior consent decree had held the patent in question valid but not infringed. The consent decree involving the patent claims in this action held the patent valid and infringed. We need not decide whether the distinctions between the two cases can justify a difference in treatment because we believe Eclipse effectively waived any rights it might otherwise have to challenge the validity of Maxon's patent through its actions during the course of the trial. p.14,15

The trial court's decision in this case, following a lengthy trial, was entered on July 2, 1971. *Lear, Inc.* v. *Adkins, supra*, was decided on June 16, 1969. Yet Eclipse n.9

[3] The relevant district court finding reads as follows:
"Only the infringement of claims 3, 7, 8 and 10 of the reissue patent are in issue. Eclipse having admitted the original patent 2,051,464 is valid, and therefore the claims in issue here are valid by virtue of the fact that they are identical to the same claims in the original patent."

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did not raise the issue of patent validity with respect to the claims found to be infringed until August 9, 1971, when it filed a post-trial motion in the district court. Prior to this belated action, counsel for Eclipse had stated, during trial, that they admitted "that the issue of validity so far as the original claim is concerned is not here in issue." Eclipse also conceded in the stipulated facts submitted prior to trial that if any of the claims here in issue were held to be infringed, the patent would be enforceable against the defendant.

p.14

A properly issued patent is presumed to be valid and the burden of proving invalidity rests upon the person challenging validity. 35 U.S.C. §282. In this case, the failure to offer proof on the question of validity, particularly when coupled with statements admitting the validity of the patent claims, precluded Eclipse from belatedly attempting to contest validity after the trial was over.[4] A contrary determination would disregard the statutory requirement, enabling a defendant in an action for infringement to avoid its burden of proving invalidity during the initial trial. The result would be either to force the plaintiff to prove affirmatively the validity of the patent in question or to give the defendant what would amount to a second chance to prove its non-liability to the patentee if the ruling on infringement went against it. Although public policy encourages tests of patent validity, *see Blonder-Tongue Laboratories, Inc.* v. *University of Illinois Foundation*, 402 U.S. 313, 344-45 (1971), public policy also favors conservation of judicial time and limitations on expensive litigation. *Id.* at 334-49. None of these policies would be served by a ruling which permitted a party to contest validity only when the close of the trial revealed that it had lost on the issue of infringement. We conclude that the district court was correct in ruling that Eclipse waived its right to contest validity regarding the claims held to be infringed by the trial court.

p.15,b

p.15,c

p.27 K,L,M

II.

Eclipse contends that Maxon's claim is barred by laches. Eclipse began manufacture of the burners in suit

[4] In contrast to the present case, defendants in *Business Forms Finishing Service, Inc.* v. *Carson*, *supra*, attempted repeatedly to attack validity. 452 F.2d at 73 n.9.

in 1963. Maxon gave Eclipse notice of infringement on October 12, 1967. This suit was filed on January 23, 1968. Eclipse argues that it was entitled to rely on Maxon's "acquiescence" during the intervening period, and that its reliance cost it a quarter of a million dollars in production costs. Acquiescence is predicated on Maxon's knowledge of the Eclipse burners now charged to infringe Maxon's patent. p.8

The district court rejected Eclipse's argument for two reasons. First, it held that Maxon had a policy of one infringement suit at a time and that Maxon was involved in two such suits from 1962 until 1967. Second, it found that Eclipse's own conduct had prevented Maxon from obtaining complete knowledge of the construction of the accused assemblies until the period of February to May, 1966. In March, 1963, and again on July 20, 1965, counsel for Eclipse sent Maxon's counsel drawings of the purported AH burners. In each case, the drawings were for burners having mixing plates with uniformly sized openings, and not the non-uniform apertures present in the actual Eclipse burners and required by the Maxon patent. The district court found that Maxon did not purchase an Eclipse burner until January, 1966, at which time it was of course informed of the non-uniform openings. p.16(2) p.19

We need not decide whether the evidence adequately supports Maxon's contention that it was prevented from acquiring complete knowledge of the characteristics of the Eclipse burners until 1966. Assuming that Maxon can be charged with knowledge prior to this date,[5] we do not think its delay in filing suit barred injunctive relief against future infringement.[6] This court held in *Armstrong* v. *Motorola, Inc.*, 374 F.2d 764, 769 (7th Cir.), *cert. denied*, 389 U.S. 830 (1967), *rehearing denied*, 389 US. 997, that "[a] suit pending to sustain the validity of a p.19 p.17

[5] The district court findings indicate that Maxon had access to Eclipse's burners in the hands of Maxon's customers and had in its possession Eclipse's advertisements showing non-uniform holes prior to the 1966 "discovery." p.16(2)

[6] Although Maxon originally sought treble damages, the district judge awarded only injunctive relief and Maxon has not appealed the denial of monetary relief. This court noted the differences in dilatory conduct which might bar monetary damages but not injunctive relief in *Continental Coatings Corporation* v. *Metco, Inc.*, ... F.2d .... (7th Cir., July 21, 1972, No. 71-1266), slip opinion at 6-9. p.17 n.12

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patent is notice to all infringers of the insistence of the patentee upon his claimed rights." Here, Eclipse had full notice that Maxon intended to enforce its patent rights by reason of Maxon's earlier infringement action against Eclipse.[1] Maxon was subsequently involved in litigation to enforce its burner patent against Mid-Continent Metal Products Company. This suit was not concluded until September 22, 1967. *See Maxon Premix Burner Co.* v. *Mid-Continent Metal Products Co.*, 279 F. Supp. 164 (N.D. Ill. 1967). Maxon gave Eclipse formal notice of infringement one month later, on October 12, 1967. If Eclipse had any doubts as to Maxon's intentions and the effects of future Maxon actions on its own interests, the proper course of action would have been an action for declaratory judgment against Maxon. Sufficient notice having been given Eclipse, it cannot now complain of the action filed against it.

n.18 p.16: (1) (4) p.27N

III.

Eclipse advances various theories under which it believes the trial court's findings on infringement should be reversed. The standard for review is set by Rule 52(a) of the Federal Rules of Civil Procedure, which requires this court to uphold the factual findings of the district court unless they can be said to be "clearly erroneous." This is particularly true when, as here, the trial court's decision is based upon "consideration and weighing of the most credible evidence, both testimonial and documentary, and evaluation of visual courtroom demonstrations and demonstrative physical exhibits. . . ." (Trial court decision, F.F. 8). *Wahl* v. *Carrier Mfg. Co.*, 358 F.2d 1, 3 (7th Cir. 1966).

p.2B p.4F

The district court found that Eclipse's AII burners encompassed all of the elements of Maxon's patent claim 3, including a low-rate burner structure, shielding walls and mixing plates extending obliquely forward and outward in widely divergent relation. The court also found that the operating and performance characteristics of Eclipse's

p.4F p.12,13

[1] Eclipse was given additional notice in January, 1966, when counsel for Maxon wrote Eclipse, stating that its silence regarding an earlier letter from Eclipse "should not be construed as any acquiescence or concurrence in the opinions expressed in [that] letter," and that in counsel's opinion, Eclipse was infringing Maxon's patent claims.

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burners were the same as those found in plaintiff's invention. Contrary to Eclipse's assertions, these findings were of an essentially factual nature and are well supported by the evidence. We shall, however, discuss each of these contentions. p.12,13 p.2B,4F

Eclipse alleges that the accused burners differ from the patent claims in that combustion does not occur "independently of and shielded from the passing air stream." According to Eclipse's theory, since air from the air chambers supplies combustion air without which combustion could not occur, the Eclipse burners do not come within the claim language. However, as the district court noted, "independently of" is logically construed to mean undisturbed and unharmed by the passing air stream, and "shielded from" implies that the combustion is protected and separated by the shielding walls from the passing air stream. The district court found that the language had been inserted to distinguish the patentees' invention from prior art jet engine combustion. Furthermore, the patented claims themselves contemplate that the burner may take some air from the passing air stream for use in combustion. Both the accused burners and Maxon's claimed invention burn air-gas mixtures in a shielded zone independent of the passing air stream. Defendant's contention is therefore without merit.[8] p.11 n.6 n.6 p.25C n.20 n.6

Eclipse's next argument relates to the claim language which requires a burner "for operating in and for heating a low-pressure air stream flowing forwardly past the burner at a velocity of the order of 1500-4000 feet per minute." Eclipse insists that its burners do not infringe the claim language in two respects. In the first place, it is argued, the Eclipse burners do not meet the claim language because they use outside air, not air-stream air, in the air chambers. The district court rejected both the factual basis for this claim and its relevance to the claim language. We find no basis for disturbing these findings. Eclipse also insists that its burners have air stream velocities of less than 1500 feet per minute. This factual con- p.13 p.25A p.11 p.25B

[8] Defendant also relies on file wrapper estoppel as a ground for reversal of the findings relating to this claim. The district judge adequately disposed of this contention and we will not extend this opinion through a lengthy analysis of an essentially frivolous claim. *See* F.F. 109-110; *Paper Converting Machine Co.* v. *F M C Corporation*, 409 F.2d 344, 354 (7th Cir.), *cert. denied*, 396 U.S. 877 (1969). p.2A p.26H n.21

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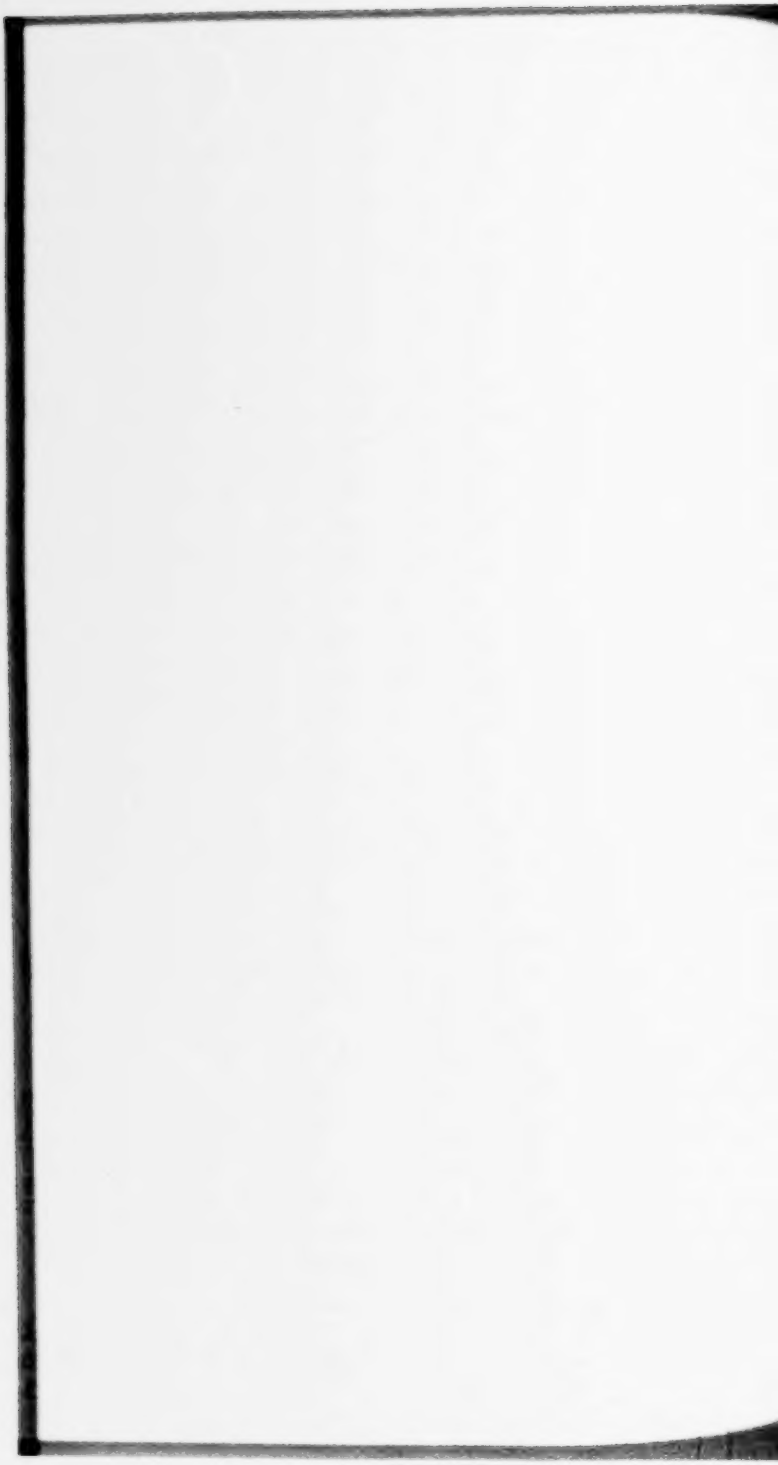

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tention is contradicted both by the stipulated facts and the district court's findings. Although defendant argues that the revelant speed should have been measured at a different location, its argument is unconvincing. Inasmuch as the district court observed the operation of the burner and found to the contrary, we are not prepared to disturb its finding. p.25F

Eclipse proffers a further theory of non-infringement based on the claim language which refers to "mixing plates extending obliquely forward and outwardly from said shielding walls in widely divergent relation." Eclipse's mixing plates are located at a 26° angle. Eclipse focuses on the word "widely" and would have us find that the 26° angle is not sufficiently divergent to come within this definition. In conjunction with this argument, Eclipse notes that the 26° angle is closer to that of the prior art (13-20°), which Maxon distinguished in its arguments before the patent office, than to the 50° angle shown in the specific Maxon burner exhibited in the patent. However, Maxon never alleged that a 50° angle was critical and tests indicated that Eclipse's burners would not perform adequately when an angle approaching that of the prior art was used in place of its 26° angle. Eclipse's contention that Maxon argued before the Patent Office that a 50° angle was critical was found by the district court to ignore the fact that the Patent Office allowed the asserted claims without the supposedly critical 50° angle, although such an angle is recited in some of the non-asserted claims. Eclipse's theory is thus once again dependent upon a factual finding by the district court. On the basis of the record before us, we cannot accept the thesis that this finding was clearly erroneous. n.8 p.26G n.8 p.3F p.26D

Eclipse also alleges that its burners are within the scope of the prior art and that Maxon's invention was completely obvious. In support of this position, Eclipse relies on prior art jet engine patents and an unpatented heater developed by Western Products.[9] The district judge p.26J

[9] In the district court Eclipse also relied on certain prior art burner patents. Eclipse does not specifically attack the district court's findings on this point and, in the absence of more direct references, we may assume that the relevance of these patents to the issues here is no longer a subject of dispute. p.26I

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heard testimony and witnessed demonstrations of this prior art and concluded that "[t]he prior art relied upon by Eclipse does not teach the accused burner assemblies, and does not restrict the asserted claims of the patent in suit from covering the accused assemblies." (F.F. 129.) We agree. p.26I p.13-15

The first of the patents relied upon by Eclipse was Way et al Patent No. 2,595,999. The Way patent covers a jet engine combustion device utilizing liquid fuel, a turn-down ratio of 10-1, and extremely high air velocity. The district court noted numerous differences between the jet engine patents and the burners in suit, a few of which are mentioned here. In contrast to the high turn-down ratio described in the Maxon patent and present in the Eclipse burners, the Way patent contemplates a relatively low turn-down ratio. In the accused assemblies and in the Maxon invention, the air stream flows forwardly past the burner, while in the jet engine the air stream flows through the flame baskets. Combustion in the burners in issue here takes place "independently of air from the passing air stream" whereas in the jet engine combustion takes place within the air stream itself. The Way jet engine has no mixing plates and no shielding walls. We are satisfied on the basis of this evidence that the district court was correct in concluding that the Way patent could not teach the Maxon patent in question nor provide a basis for a charge of infringement. It follows that Eclipse cannot assert the prior art jet engine patents as a defense to a suit for infringement. p.26I p.12-13 n.6 n.5 p.26I p.13-15

Eclipse also relied on an unpatented heater developed by Western Products as prior art which "stands between" the Maxon patent and Eclipse burners. The Western Products heater was developed in 1957, after the Maxon burner had been completed but before Maxon filed its original patent application. Western's heater was found by the district court to be significantly different from the Maxon and Eclipse burners. The Western Products heater was found not to embody a line burner, an elongated burner body, a low-fire burner structure, shielding wall means or mixing plates. Neither did the Western Products burner have a high turn-down ratio, the nested blue flame common in the Maxon and Eclipse burners, nor did it p.26J p.26I

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operate in an air stream velocity similar to that associated with the burners involved in this suit. Eclipse does not directly attack these findings but insists that because the Western Products heater has diverging perforated plates and somehow "taught" the high turn-down feature of the burners in suit, it is prior art which prevents a finding of infringement here. Eclipse fails to explain in what manner the Western Products burner teaches the turn-down ratio in the Maxon patent and Eclipse burners, but the district court findings indicate that Eclipse contends this is unimportant to the Maxon patent. However, as the district court noted, the capability of the Maxon and Eclipse burners to achieve a high turn-down ratio is indeed an important characteristic of the Maxon patent. In any event, our own study of the record fails to indicate that the Eclipse high turn-down ratio could have been taught by the original Western Products burner.[10] Eclipse's argument regarding diverging perforated plates in the Western Products burner is equally without merit. The district court found that the original Western Products heater did not have mixing plates that operated in a manner similar to the mixing plates found in the Maxon and Eclipse burner. Furthermore, the conical structure, which Eclipse contends is equivalent to mixing plates, had uniformly sized openings whereas the patented burners and the Eclipse burners all have non-uniform openings.

p.26I 13-15

In conclusion, we can find no basis for overturning the district court's holding of infringement.[11] The factual findings are well supported by the record and neither Eclipse's theories of estoppel nor the asserted prior art create a defense to Maxon's right to an injunction against further infringement of the Maxon patent.

p.25D

[10] The Western Products heater fabricated by the defendant for use at trial was found, indeed admitted, to be unlike the original Western Products burner in significant respects. Only the original Western burner was relevant, however, as prior art. Furthermore, Western Products itself entered into a consent judgment with Maxon and did not raise its own heater as evidence of invalidity. This may be some evidence that Western Products did not think the special features of the Maxon invention, and thus Eclipse's burners, could have been taught by tis prototype burner.

p.26I

[11] We have considered additional arguments raised by Eclipse and have found them to be without merit.

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IV.

Maxon cross-appeals from the decision of the district court which held that a prototype burner assembly manufactured and sold in 1963, having mixing plates with uniformly-sized apertures, did not infringe the Maxon patent claims. Maxon insists that this prototype was not an issue in the case and that no evidence was introduced by either side which would show what the prototype looked like, how it operated or whether it infringed the Maxon patent. We agree.

The district court held that the 1963 prototype was in issue by virtue of Maxon's complaint in this action. Paragraph 8 of the complaint reads as follows:

> "8. Since August 28, 1962, [the date on which the Maxon patent issued] and prior to the filing of this complaint, defendant Eclipse Fuel Engineering Company has been and still is infringing plaintiff's rights as secured to it by said reissue Letters Patent No. Re 25,626 by manufacturing, using, selling, and actively inducing others to use and sell apparatus embodying the invention defined by its claims, for example, its Series AH and RAH burners, without the consent of the plaintiff . . . ."

The complaint is, therefore, broad enough to cover the 1963 prototype burner.

Our belief that Maxon is not simply backtracking on an original assertion of infringement in the face of a district court holding which makes a positive finding of non-infringement is based on several factors. Maxon carried the burden of proving infringement by the Eclipse burner. Yet Maxon produced no evidence relating to infringement by the 1963 prototype although such proof would have been manifestly necessary in view of the seeming impossibility of reconciling the 1963 burner, with its uniform apertures, with the claim language which called for non-uniform openings.[12] Most probably, evidence would

[12] Claim 3 of the patent describes the non-uniform apertures as follows: "apertures at the inner portion of the mixing space, adjacent said shielded zone, being relatively small and being proportioned to cooperate with said variable low-rate burner to provide air for progressively increased combustion, . . . the apertures at outer

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have been called for which would have brought the 1963 burner within the doctrine of equivalents. Although Maxon should not be excused for failing to produce such proof if the burner was really in issue, its failure to do so in this case is some evidence that it did not intend to allege infringement.

An additional indication that the 1963 burner was not intended to be charged with infringement is provided by Maxon's argument relating to laches. One of Maxon's principal arguments for not bringing suit at an earlier date was that it believed the only burners being produced by Eclipse had uniform apertures which presumably would not infringe the Maxon patent. As the district court noted, if this argument could excuse Maxon for not bringing an earlier action, it might also provide a bar to an action for infringement by this burner now. p.27P

Consideration of an opposite holding on infringement by the district court provides a more persuasive argument for a determination that there should be no finding on infringement by the 1963 prototype at this point. If the district court had held that the 1963 burner did infringe the Maxon patent, Eclipse might well have argued on appeal that the holding was merely an advisory opinion. Eclipse made the 1963 prototype only experimentally and sold, if there was in fact a sale, only one such burner. 28 U.S.C. §271(a) provides that "whoever without authority makes, uses or sells any patented invention . . . . infringes the patent." This circuit has held that a threatened use, under appropriate circumstances, is sufficient to uphold a claim for infringement. *Fehr* v. *Activated Sludge*, 84 F.2d 948, 951 (7th Cir. 1936). However, in this case, no models with uniform holes have been produced since 1963. Defendant has not at this time even threatened to recommence production of these burners. Assuming, therefore, that Maxon would not be barred by laches from bringing an action for infringement by the p.27P

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[3] (Continued)

portions of said mixing space being larger and being proportioned to supply additional air for progressively higher rate combustion . . . whereby said burner may be adjusted in operation from a high rate involving combustion at substantially all said air jets, through substantially continuous variation, down to a low rate of combustion at said low-rate burner inwardly of said air jets."

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1963 burner, the doctrine of *de minimus non curat lex* would apply.

p.28

Finally, our holding is compelled by defendant's own actions. In response to Maxon's interrogatories seeking information regarding the 1963 burner, Eclipse replied that if such a burner was now in existence, its location was unknown. Maxon should not be prevented from ever attempting to show that a burner like the 1963 prototype would infringe its patent when it has never been given a realistic opportunity to prove infringement.

The district court judgment holding that the Eclipse family of burners infringes the Maxon patent will be affirmed. The judgment finding non-infringement by the 1963 prototype will be reversed.

AFFIRMED IN PART, REVERSED IN PART.

A true Copy:

Teste:

.....

Clerk of the United States Court of Appeals for the Seventh Circuit.

USCA 4013—The Scheffer Press, Inc., Chicago, Illinois—9-18-72—200

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ADDENDUM V

DENIAL OF PETITION FOR REHEARING
UNITED STATES COURT OF APPEALS
FOR THE SEVENTH CIRCUIT

Nov. 1, 1972

Hon. ROBERT A. SPRECHER, Circuit Judge

Hon. JAMES R. DURFEE, Senior Judge

Hon. JESSE E. ESCHBACH, District Judge

The appellant has filed a petition for rehearing and both parties have pointed out to the Court that due to a printing error the judgment order of the district court was not included in full text in the appendix and that such error misled this Court in one statement in footnote 6 of the opinion of September 18, 1972.

IT IS ORDERED that footnote 6 be amended to read as follows:

> "Although Maxon originally sought treble damages, the district court denied treble damages but awarded injunctive relief and an accounting of actual damages. The denial of treble damages was not appealed."

Defendant-appellant's "Motion for Extending Time to Suggest In Banc Rehearing" was taken as a suggestion for an en banc hearing and was circulated to all active judges. No judge in active service having requested a vote thereon, nor any judge voted to grant the suggestion, and all members of thepanel having voted to deny a rehearing,

IT IS ORDERED that the petition for a rehearing in the above-entitled cause be and the same is hereby denied.

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ADDENDUM VI

LETTER OF MAXON'S COUNSEL MENTIONED IN FOOTNOTE 7 OF OPINION OF COURT OF APPEALS AND LATER CHARGE OF INFRINGEMENT

[The first item was described in the Court's footnote as "stating...that in counsel's opinion, Eclipse was infringing Maxon's patent claims."]

January 14, 1966

Mr. Norman H. Gerlach
105 West Adams Street
Chicago, Illinois

Dear Norman:

Re: Eclipse "AH" Air Heater Burner

Reviewing the subject file, I noted that we apparently neglected to reply to your letter of July 20, 1965.

For the record, our silence should not be construed as any acquiescence or concurrence in the opinions expressed in your letter. Specifically, we do not agree that directing air-stream air through a fan to the burner is any different than permitting the air-stream air to impinge directly on the burner. In short, the Eclipse "AH" burner apparently is doing "indirectly" exactly what Maxon's "does directly".

If you have any further comments, we would appreciate receiving them at your convenience.

Sincerely yours,

/s/ Granger

[In the following notice of infringement, the two drawings referred to in the third paragraph are drawings submitted by Eclipse to Maxon in the 1963 settlement negotiations of prior litigation, mentioned in the petition, above.]

October 12, 1967

Mr. Norman H. Gerlach
Suite 3226
105 West Adams Street
Chicago, Illinois 60603

Dear Mr. Gerlach:

Re: Eclipse Air Heating Burners
Series AH and RAH

As you know, our client, Maxon Premix Burner, has had a patent infringement action pending against Mid-Continent Metal Products. A few weeks ago, on September 22, 1967, Judge Lynch entered judgment for Maxon. He held the Yeo et al. patent No. Re. 25,626 to be valid, and to be wilfully and wantonly infringed. Judge Lynch awarded treble damages, attorneys' fees, and costs to Maxon. Mid-Continent recently filed a notice of appeal.

You will remember that several years ago Maxon Premix Burner filed a patent infringement action, charging infringement of this same patent, against your client, Eclipse Fuel Engineering Co. and, as a result, Eclipse discontinued the manufacture and sale of the accused burner (Series AS Air Stream Burner). Sometime thereafter, Eclipse commenced the manufacture and sale of its Series AH and RAH burners.

The first form of this Series AH and RAH

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burner is illustrated in Eclipse's drawing No. 3TH-1754, entitled "Experimental Nozzle Mixing Burner", and dated 12-13-62, as well as in Eclipse's layout drawing entitled "Installation of Nozzle Mixing Line Burners in Airstream" by Lyle Spielman, and dated 1/22/63. As shown, the combustion air blower is located externally of the duct and supplies non-airstream air to a manifold surrounding a high turn-down burner structure.

Eclipse modified this Series AH and RAH burner so that the combustion air blower is integrally attached to the burner. With this construction, airstream air is supplied to the combustion air blower which, in turn, supplies this air to the burner structure. In our letter to you of January 14, 1966, we stated that "directing airstream air through a fan to the burner is (not) any different than permitting the airstream air to impinge directly on the burner". This modified Series AH and RAH burner has been illustrated in several of Eclipse's bulletins and has been installed and operated in many locations. Maxon considers Eclipse's manufacture and sale of its modified Series AH and RAH burner to be an infringement of the above Yeo patent, and Eclipse is specifically requested to cease and desist from further infringing activities.

In addition, the Series AH and RAH burners have been further modified by eliminating the combustion air [blower] entirely. Certain of Eclipse's bulletins, for example Spec. Sheet H-100-1 state that "when operating on the suction side of the circulating fan, under certain conditions it is possible to operate without the use of a combustion air blower". These further

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modified burners have also been installed and operated in many locations. Maxon considers Eclipse's manufacture and sale of its further modified Series AH and RAH burner to be an infringement of the above Yeo patent, and Eclipse is requested to cease and desist from further infringement.

We, of course, could have filed another patent infringement suit against Eclipse without first giving this notice. However, inasmuch as Eclipse previously has questioned the procedure of initiating discussions of an infringement issue by filing a lawsuit, we thought that we would first communicate directly with you. However, you should know that we are authorized to take whatever legal action is necessary to protect Maxon's patent rights.

Please let us know whether or not Eclipse will stop its infringing conduct and respect the patent rights of Maxon. We shall look forward to hearing from you at an early date.

Sincerely yours,

/s/ Granger
[Granger Cook, Jr.]

CHART A-60

LIST WITH SHOWING OF ACQUIESCENCE

marketed AIRFLO burner, sought patent.

n added limitations, filed affidavits.

e marketed similar burner ("AS").

s original patent issued.
filed prior suit against Eclipse (no prior
Eclipse promptly discontinued its burners.

tlement negotiations Eclipse disclosed
ntial" drawings for a basically different
laxon concurred in its noninfringement.
n filed reissue application, but did
dvise Eclipse.
settled and consent judgment entered.
a markets "AH" line (prototype first)
at convention, with bulletin.
a enlarged some holes.

a issued new bulletin, new hole size
. Maxon received copy.
ssue patent (in suit) issued to Maxon,
still not told.
xon seeks from Eclipse -- and is given --
nce information, also drawing and
xplaining points of noninfringement.

replies to foregoing. Using its first
ght theory, Maxon disagrees on one
t does not charge infringement.

xon charges infringement, some burners
plaining by listing changes in those
h '63 showing, but not hole size.

iled. More afterthought theories, in-
ole-size excuse for laches, gradually
nd reach to burners not charged before.

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continues as to burners using outside or
a" air in the air chambers for combustion.

FOLDOUTS TOO LARGE TO BE FILMED